SCIENTIFIC AMERICAN

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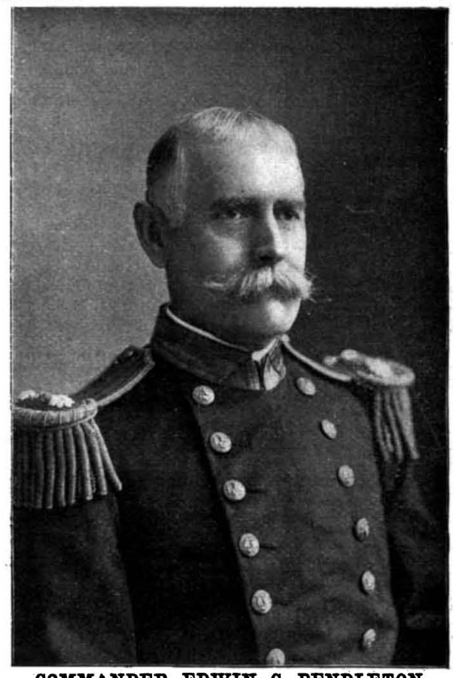
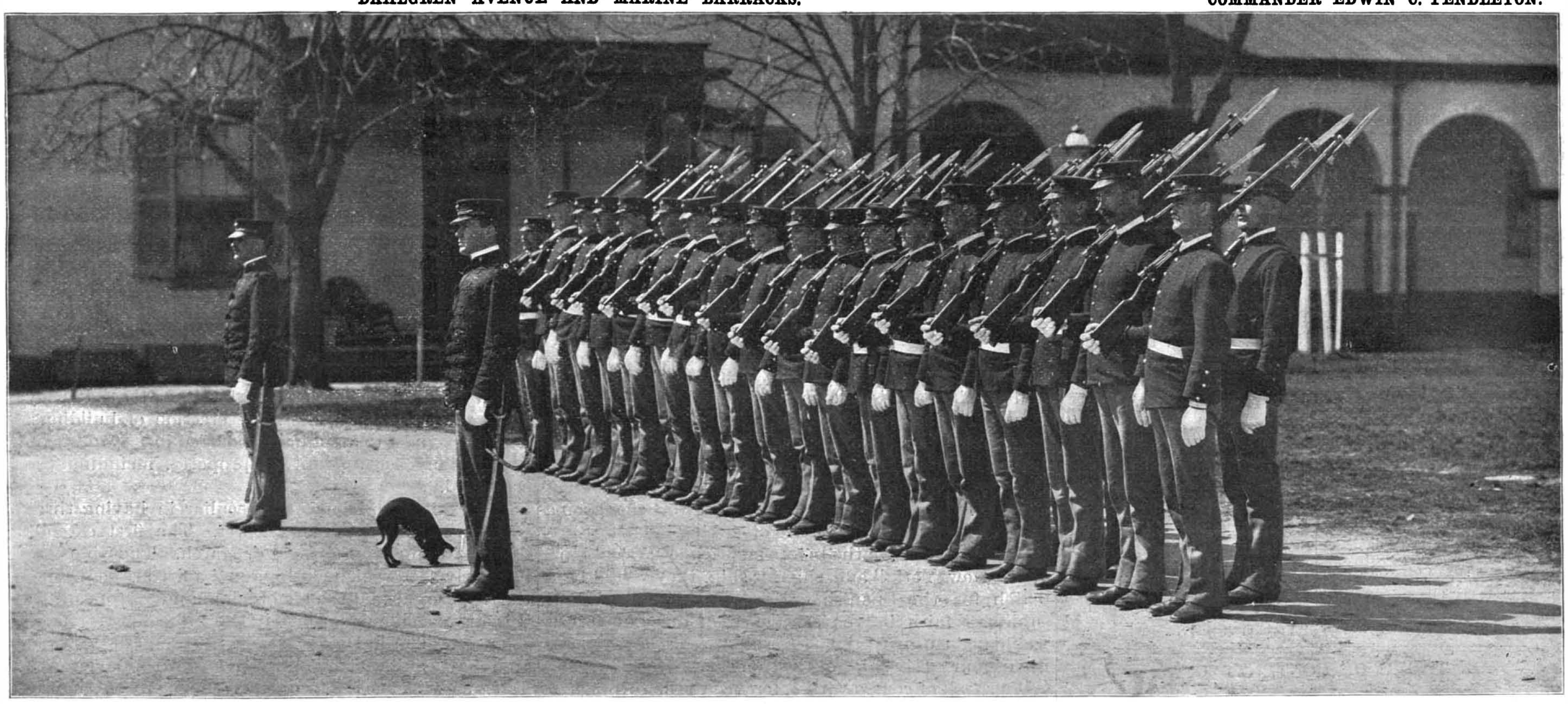
DAHLGREN AVENUE AND MARINE BARRACKS.



COMMANDER EDWIN C. PENDLETON.



MARINES DRILLING.

DAHLGREN AVENUE. GUN SHOPS.

EXPERIMENTAL MODEL TANK.

THE WASHINGTON, D. C., NAVY YARD.—[See page 295.]

Scientific American.

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NEW YORK, SATURDAY, MAY 7, 1898.

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(Illustrated articles are marked with an asterisk.)

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Scientific American Supplement

No. 1166.

For the Week Ending May 7, 1898.

Price 10 cents. For sale by all newsdealers.

NAVAL APPROPRIATION BILL.

The liberal appropriation of $57,000,000 for the increase of the navy which has been agreed upon and reported to Congress is by far the largest sum ever voted for the purpose. The bill calls for the expenditure of $32,000,000 more than the appropriation for the current year and $19,000,000 above the sum voted by the House, most of the amendments made by the Senate being adopted by the conferees.

The bill calls for the construction of three first-class sea-going battleships, to carry the heaviest guns and armor, the cost of each ship, exclusive of armor and armament, to be $3,000,000. It also provides for four coast defense monitors, each to cost $1,250,000; sixteen torpedo boat destroyers and twelve torpedo boats to cost $6,900,000 and one gunboat for service on the Great Lakes to cost $260,000. Fully as important as the construction of warships is the matter of dry docks, and we are glad to note that four first-class docks, to cost $825,000 each, are to be built, one each at Portsmouth, Boston, League Island and Mare Island. In addition to these a steel floating and graving dock is to be built at Algiers, La. The Senate amendment calling for $1,000,000 for the construction of new buildings for the Annapolis Naval Academy was agreed to by the conferees.

Taken altogether, the programme of new construction is an excellent one and, with one important exception, it meets the more pressing needs of the navy. The exception is to be found in the fact that there is no provision for building any more of those invaluable armored vessels, like the "New York" and the "Brooklyn," which combine the fighting qualities of the battleship with the speed of the cruiser, and are known as armored cruisers.

The armored cruiser carries sufficiently heavy armor and guns and has sufficient speed to enable it to fight or avoid almost any type of warship afloat in the world to-day. Our own "Brooklyn" can catch all but a very few of the fast cruisers afloat, and her battery is so powerful that she would stand more than an even chance of silencing any but two or three of the latest ships of her type. With these exceptions, she could sink or capture any kind of vessel outside of a battleship, and there are many of this type that would be badly used up in a duel with either the "New York" or the "Brooklyn."

Now it is the lack of mobility or the power to move swiftly from place to place that severely handicaps the battleship or monitor in its attempt to protect a long stretch of coast line, such as we possess. The Spanish fleet, which is reported to have sailed for the west, has a speed of 20 knots, none of the vessels being slower than that. Such a fleet could cruise in the same waters as a fleet of 15 or 16-knot battleships for months, without the latter being able to bring it to an engagement. Nor would it be prudent to dispatch our swift protected cruisers, like the "Columbia" and "Minneapolis," "San Francisco" and "New Orleans," against the Spanish boats with their 12-inch armor and 11-inch armor-piercing guns.

We must oppose armor to armor-piercing guns, and armor-piercing guns to 12-inch steel belts, and must have speed to match speed, if we are to bring such a fleet to battle and make sure of sinking it.

It is true we have the before mentioned "Brooklyn" and "New York," and, ship for ship, they would be a match for the Spanish cruisers; but not even our sublimest faith in the excellence of our gun crews would make us trust these two ships to the concentrated fire of four or six ships of the same class.

We speak of course with reference to the future; for even if armored cruisers were ordered, they would not be available for service until long after the present war is finished. At the same time it is evident to any one who watches the trend of events that the speed of modern armored warships is rapidly increasing. The "Yoshino," 12,320 ton battleship, built for the Japanese navy, has a speed of 19½ knots, the 13,860 ton battleship "Sardegna," of the Italian navy, can steam 20 knots, and armored vessels such as the "O'Higgins," 8,500 tons, and "Esmeralda," 7,000 tons, of the Chilean navy, will steam 21½ and 23 knots respectively.

Superior speed is to the modern warship what the weather gage was to the sailing frigate. It enables the faster vessel to fight or not, as she pleases, and enables her to place herself at whatever fighting range is best suited to her capacity. The ability of a warship to protect an exposed coast line is largely in the ratio of her speed, and, for quick concentration at strategic points, speed is obviously of the greatest value.

We think that if two swift and armored cruisers of the type of the Brooklyn were substituted for one of the battleships and one of the coast defense monitors, we should be so much the better prepared to meet the possible ravages of high speed armored craft in the future.

TRAVEL on the Bulawayo Railroad is exciting. The Shashi River rose recently four feet above the bridge tracks, so that engines could not cross. A train was made up as long as the width of the river, pushed across by one engine, and taken up on the other side by another. Soon after the bridge was washed away.

THE PHILIPPINE ISLANDS.

During the last few days attention has been directed toward the Philippine Islands, the objective point of the United States Asiatic squadron, which sailed from Hong-Kong on April 27, to engage the Spanish fleet. The Philippine Islands are an archipelago southeast of Asia. They extend almost due north and south from Formosa to Borneo, and they separate the South China Sea from the Pacific Ocean. The number of islands in the Philippines is variously estimated from 1,200 to 1,400, and it was not until the last few years that some of the larger islands were explored sufficiently to enable their area to be accurately computed. According to Domann's map (1882) the area of the islands was 114,356 square miles. The two largest islands are Luzon (area, 40,024) and Mindanao. Their aggregate area is 52,650 square miles.

The islands were discovered by Magellan in 1521, and Manila, the capital, was founded by Legaspi in 1571, and since that time they have been under the dominion of Spain. Their conquest and retention was in marked contrast to the usual Spanish methods of dealing with conquered people, methods of which Cortez and Pizarro are the chief exponents. Legaspi with six Augustinians and a handful of soldiers accomplished the wonderful work of conquest. Without greed for gold and without any exhibition of cruelty or persecution, these devoted men labored among the docile people until they won their confidence, so that the islands were seized with little bloodshed and no massacre or depopulation. The name "Islas Filipas" was given by Legaspi in 1567. Contests with frontier rebellious tribes, attacks by pirates, earthquakes and typhoons serve to break up the monotony of an otherwise uneventful history.

Manila was captured by the English under Draper and Cornish in 1762, and ransomed for $5,000,000, but was restored in 1764. The present insurrections in the islands were put down with an iron hand and many atrocities were committed, so that it is little wonder that many of the inhabitants look upon the arrival of the Americans as a deliverance.

While none of the islands have very high mountains (the highest, Apo, in Mindanao, being over 9,000 feet), still all the islands may be described in general as mountainous and hilly. Volcanic forces have had a large share in shaping the archipelago, but few of the peaks are now volcanic. In 1814 a terrible eruption destroyed 12,000 people at Camalig, Budiao, Albay, Guinobatan and Daraga. In 1867 the same district was visited with another eruption. The Philippines are also notorious for terrible typhoons. In 1876 one of the storms burst over Luzon, pouring down the sides of the mountain Mayon, bringing destruction to a number of cities, completely ruining 6,000 houses. Typhoons on the coast are also common. The third great evil to which the islands are treated are the earthquakes, which visit them so frequently that they affect the style adopted in the erection of buildings. The most violent earthquake occurred in 1880, destroying an immense amount of property, including the cathedral.

The Philippine Islands are peculiar in having three seasons—a cold, a hot and a wet. The first extends from November to February or March. The winds are northerly and woolen clothing and a fire are desirable, the sky is clear and the air bracing, and Europeans in this strange clime consider it the pleasantest time of the year. The hot season lasts from March to June and the heat becomes oppressive and thunderstorms of terrific violence are frequent. During July, August, September and October, the rain comes down in torrents and large tracts of the lower country are flooded. The population of the Philippines is 7,670,000, the capital, Manila, having 154,062 inhabitants. There is a small Spanish resident population and about 100,000 Chinese, in whose hands are the principal industries. The native inhabitants are mostly of the Malayan race. The government is administered by a governor-general and a captain-general, and the forty-three provinces are ruled by governors, alcades or commandants, according to their importance or position. The estimated revenue of the islands in 1894-95 was $13,500,000 and the expenditure $13,200,000. There is an export duty on tobacco and nearly every article imported is taxed. The chief products are sugar, hemp, coffee and indigo, and there are large coal fields which are now being opened, so that it is expected that 5,000 tons of coal per month may be mined. The imports in 1896 were about $12,000,000 and the exports $20,500,000. There are 70 miles of railway on the islands and 720 miles of telegraph.

Manila lies on the western side of the island of Luzon and is about 600 miles from Hong-Kong. It has one of the most spacious and beautiful harbors in the world. The shores are low and inland can be seen the outline of mountains. The city of Manila resembles a dilapidated fortress surrounded by stone walls 300 years old. There is also a wide, shallow moat. The gates are never closed and it is doubtful if the city could make any defense. There is also an old fort. Several creeks branch off from the landlocked bay and afford a means of communication with the suburbs.

These creeks are crossed by innumerable bridges, and canoes thread their way through these narrow waterways, which somewhat resemble a tropical Venice. Around the walls and the edge of the bay is a fashionable drive lined with almond trees. It is here that the well-to-do inhabitants walk, drive and meet their friends. Of nearly 300,000 people in the province there are not more than 5,000 Spaniards. One of the most curious sights to the traveler who comes from China are the large two-wheel drays drawn by so-called water buffaloes. They are guided by a ring through their nose to which is attached a cord leading back to the driver, who either mounts on his back or rides on the shafts. The weight of the load is borne on the neck by means of a yoke. The beasts are docile and their chief delight seems to be to wallow in the mud and to submerge themselves so that only the nose is out of the water. The water buffalo is particularly valuable to the inhabitants as a beast of burden, as it can drag a plow and can walk while knee deep in mud. The milk of the female is very generally used instead of cow's milk, but its meat is unfit for food.

In the two best streets of Manila there are excellent stores in which goods of all kinds can be purchased at moderate prices, many of the merchants being Chinese. The churches must have been imposing buildings years ago before they were shaken and in some cases wrecked by earthquakes. They contain no works of art of any value. The inhabitants are very faithful to their church and the archbishop possesses almost unlimited influence with the inhabitants. It has often been said, if the priests were taken away, the natives would be ungovernable. The dwelling houses in Manila are constructed with a view of shutting out the intense heat of the summer. The houses are rarely more than two stories in height, owing to the ravages of earthquakes. Glass is of course unknown, as the earthquakes would shiver every pane. There is coal in abundance in the Philippine Islands, as already stated, and the streets of Manila would undoubtedly be lighted with coal gas if it were not for the fact that gas pipes would be destroyed in the unstable soil. Of course, accidents are of frequent occurrence with kerosene, but as the natives' houses are very inexpensive, their loss by fire is easily made good.

Strange to say, life in the old city does not present many points of interest to the traveler, for the streets are narrow and the houses solid and gloomy. It is a marked contrast to the businesslike cities of South America. The Spaniards born in the Iberian Peninsula look down upon those born in the islands, so that class distinctions are very closely drawn. This has resulted in the failure to make political combinations. Hatred and jealousy of the foreigner are carried to extreme limits, the Chinese coming in for a large share of their disfavor. The theaters are poor, concerts are rare and there is no library and their amusements are mostly limited to hearing the band play, attending balls on Sundays and cock fights. The cockpits are licensed by the government, and, though the betting is limited by law, the citizens will not hold to it. The revenues of the islands are furnished by direct taxes on every Indian, half-breed and Chinese, and the export and import duties have already been referred to.

The dress of the natives is exceedingly picturesque and is never adopted by the Spanish. Cigar makers in and around the city of Manila number 22,000 and they are all girls and women with the exception of 1,500 men. They present a picturesque appearance with their native costume and huge hats intended to protect them from the rays of the sun. They make their cigars squatting on their heels or sitting on bamboo stools two inches high. They frequently come from considerable distances, going back and forth in boats. Tobacco has always been and probably will continue to be the most important product of the Philippines; and, according to the old laws, the Indians were compelled to raise tobacco in certain regions which were not adapted to growing it, even to the exclusion of other crops, but in 1883 the laws were repealed and the result was the securing of finer tobacco and better cigars, for they are now made at a higher rate. The wants of the natives are few and are easily supplied. They live along the banks of the rivers in huts made of bamboo and cane thatched with palm leaves. Some of the views in the suburbs of Manila are enchanting.

AMERICAN TRADE WITH CENTRAL AND SOUTH AMERICAN COUNTRIES.

It is thought by many that our war with Spain will interfere seriously with our trade with the countries of Central and South America and Mexico, but this is not the case. The fact is, that, barring contraband of war, goods may be sent to all of the countries in Central and South America, but, unfortunately, they are preferably carried in foreign bottoms. It is a satisfaction to know our splendid export trade with these countries will not be crippled. No gunpowder, blasting powder, cartridges, firearms, guns or gun carriages, or any article liable to be considered contraband of war will be received by any of the steamship lines trading between the United States and these countries.

With Mexico we have railway communication, and the steamers of the Ward Line, which sail under the British flag, will carry goods to these ports. Goods for Guatemala, Honduras, San Salvador, Nicaragua and Costa Rica, may be sent by the Atlas Line, which also sails under the English flag. Venezuela is reached by the Royal Dutch West India Mail Service, which, of course, sails under the Dutch flag. Colombia may be reached by the Atlas Line, which sails under the English flag. Goods for Ecuador, Peru, Bolivia and Chile may be sent by the steamers of the Merchants' Line, which sail under the English flag. The vessels of this line are owned by the New York and Pacific Steamship Company, Limited, Messrs. W. R. Grace & Company being the agents. Goods for Argentine Republic, Uruguay and Paraguay may be sent by either the Prince Line or the Norton Line, both of which sail under the protection of the British flag. San Domingo may be reached by American lines, as there is little danger, as the Gulf will be protected by our war fleet. Hayti may be reached by the French Line and the Atlas Line, which, as already stated, is under the protection of the English flag. It is not likely that trade will be interfered with in the slightest degree except as regards goods sent on consignment, for in a circular of one of the lines we find the following: "No cargo can be received which belongs either in whole or in part to any citizen of the United States or to any subject of the Queen of Spain," but this does not interfere with legitimate trade transactions. We do not always realize the enormous importance of our trade with our southern neighbors. We give below the population of the various countries we have mentioned:

Mexico	12,578,861
Guatemala	1,470,000
Honduras	450,000
San Salvador	816,000
Nicaragua	400,000
Costa Rica	265,000
Venezuela	2,323,988
Colombia	4,600,000
Ecuador	1,300,000
Peru	2,800,000
Bolivia	2,300,000
Chile	3,500,000
Argentine Republic	4,042,990
Uruguay	850,000
Paraguay	476,000
San Domingo	610,000
Hayti	950,000
Total	39,732,839

An Explosion Injures an Inventor.

Julius Chien, a Russian inventor, who manufactures a pyrotechnic toy called "How the 'Maine' was Blown Up," was badly injured by an explosion, a few days ago, in his laboratory in New York City, of several pounds of giant powder. The concussion wrecked the top floor, blew out the windows and set the place on fire. The flames were extinguished and the injured man was removed to the hospital. He was experimenting with some giant powder in connection with a toy relative to a naval engagement when in some way a cap fell into some six or seven pounds of giant powder, which was placed in the middle of the floor, resulting in an explosion. This accident is important as a warning to some of the readers of the SCIENTIFIC AMERICAN. We have received many inquiries regarding the trick match which explodes when the flame has proceeded half way down the splint. The manufacture and use of such matches is, in our estimation, extremely dangerous, and our readers are specially cautioned against experimenting in any way with even a small quantity of powerful detonating explosive, as the fulminates, giant powder, etc. The trick "How the 'Maine" was Blown Up' consisted of a piece of tissue paper with a view of the war vessel printed on it, and the shore, where a Spaniard is touching off a mine electrically. The paper was treated with some substance, probably niter, so that when the paper was lighted with a piece of burning string, the combustion followed only the line which had been stamped on the paper by the chemical. When, at last, the warship is reached, a cap of giant powder on the back is exploded, tearing the tissue paper. The toy was not particularly dangerous, but there is always danger in the manufacture of anything of this nature.

D. R. DOM strongly recommends absorbent cotton as a filtering medium, the chief advantage claimed for it being its rapidity of action, which renders it of special value in filtering preparations containing volatile or readily oxidizable constituents, such as medicated waters, spirits and ferrous preparations. The difference in viscosity of preparations requiring filtration must be allowed for by greater or less compression of the cotton plug. As a general rule, however, the cotton should be rolled into a cone-shaped plug, which is then to be pressed down carefully into the neck of the funnel in such a manner that the bulk of the cotton remains in the body of the funnel. A glass rod is then pressed gently on the cotton and the liquid poured down the rod. In the case of fluid extracts and other preparations containing much suspended or sedimentary matter, cotton is not suitable for filtering purposes.—Bulletin of Pharmacy.

Science Notes.

Mr. Charles Janet, whose work on the social Hymenoptera has been often mentioned in Natural Science, has published (Mém. Soc. Zool. France, x., 1897, pp. 302–323, pl. x.) full descriptions with figures of the artificial nests which he has used for his observations on the habits of ant colonies. He obtained the best results with blocks of plaster provided with suitable hollows covered with a sheet of glass. No earth is needed with this form of nest, and a proper degree of moisture is insured by pouring water into a tube sunk in one side of the plaster block.

T. Schloesing has devised an ingenious method of measuring the density of gases, which is based upon the balancing of two columns in an apparatus consisting of two vertical tubes, each one meter long, communicating at their lower ends by a three-way tap. Carbon dioxide or some other easily absorbed gas of known density is passed into one tube and the gas to be examined in the other; after allowing them to communicate by opening the tap, a state of equilibrium between the two gases and the air is set up in about four minutes, and the level of the invisible surfaces of separation is then determined by absorbing the carbon dioxide with potash.—Comp. Rend., cxxvi., 476.

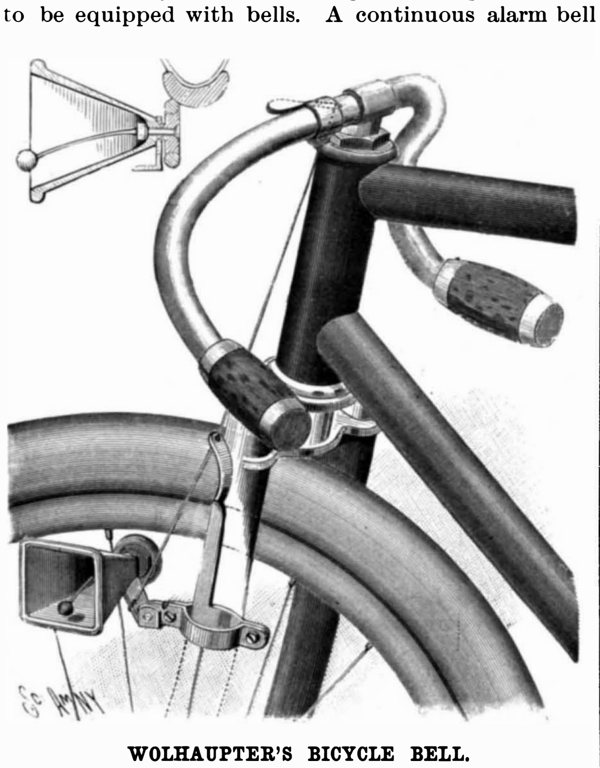
Weighings made of the brains of negroes have given between 44 ounces and 45 ounces, a weight that corresponds with European women; while in the negress the mean weight is less than in the female sex in Europeans. From the weighings which have been published of the brains of the orang and chimpanzee it would seem that the brain weight in these apes ranges from 11 ounces to 15 ounces, and the brain weight appears to be much about the same in the gorilla. These figures are greatly below those of the human brain, even in so degraded a people as the dwarf Bush race of South Africa. They closely approximate to the weight of newly born male infants, in whom the average weight is 11·6 ounces.

There can be no doubt that the most perfect method of sterilization, where it can be applied, is by heat. Baking, however, is a more or less uncertain process, while boiling is destructive to many substances. Moreover, the boiling temperature is so little above that which is fatal to microbic life that a considerable length of exposure to such a temperature is necessary, if one is to be sure that the process has been effectually carried out. Frying, however, is another matter. Olive oil at a temperature of 160° to 180° C. acts very quickly and with great power. Professor Wright, of Netley, says that to obtain complete sterilization of an instrument it suffices to dip it for an instant into the hot oil, and that in the case of syringes it is sufficient to fill them twice with oil at the temperature mentioned. The temperature of the heated oil may be determined by a thermometer; but it is often more convenient to adopt the rough and ready methods of the cook by the aid of a bit of bread crumb. "It will be found that the bread crumb will become brown and crisp as soon as a temperature of 160° to 180° is reached." For the sterilization of syringes all that is necessary is to heat a little oil in a spoon over a spirit lamp, testing it from time to time by bits of bread crumbs, and, when the proper temperature has been attained, to fill the syringe twice with hot oil. All microbial infection will then have been destroyed.—Hospital.

In the course of his lecture at the London Institution on "Insects at Work," Mr. F. Enock, after referring to the trapdoor and the garden spiders, spoke at some length on the leaf-cutting bee, probably the most remarkable of all bees. The leaf-cutter, he said, had three eyes in the center of its head (a very thick one) and two compound eyes, occupying, respectively, positions on each side of the others. In each of these compound eyes there were 11,000 reflectors, making a total of 22,000. That appeared strange; but he had proved it to be a fact by placing a locust in the lens, and then taking a photograph of the head, which showed a locust in every reflector. The photograph referred to was shown on the screen. Another peculiarity of this bee was that the tongue of the male was longer than that of the female; but this was counterbalanced, perhaps, by the fact that the jaw of the latter was very much stronger than that of the former. In explanation of the title given to this bee, it was explained that its habit was first to burrow in a sandbank, making a sort of tube for its nest. Next the intelligent creature—which was really a capital architect—would proceed to a rose tree. It would there alight upon one of the leaves, and, with the tools with which it worked, would cut a round piece out of it. This it would carry to its nest, and ram it to against the extreme top end. Then it would take an oblong piece, which it used to commence the side of a cell with; and so it would go on until it had constructed twelve cells, in each of which it would deposit its collections from the Canterbury bell, of which it was very fond, and other flowers. An egg was laid in each of these cells, and in due time young bees appeared, and in their turn escaped from the cells and flew about, to carry on the same kind of work.

A NEW BICYCLE BELL.

The bell has long been recognized to be one of the most important attachments to the bicycle, and the bells in use to-day are the result of a long series of laborious and costly experiments. Great attention has recently been paid to this bicycle sundry, owing to the fact that many cities and villages now require wheels to be equipped with bells. A continuous alarm bell

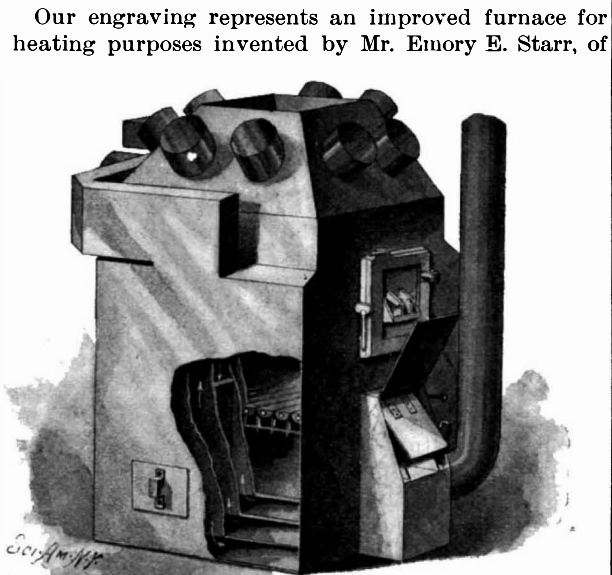


WOLHAUPTER'S BICYCLE BELL.

is now recognized to be the bicycle bell of the future; but, unfortunately, most bells of this type have been complicated by gear wheels. The subject of our illustration is a simple and gearless continuous alarm bicycle bell, invented by David P. Wolhaupter, Jr., of 1316 Twelfth Street, N. W., Washington, D. C. As will be seen by our engraving, the bell has a very positive action and at the same time is extremely simple, and is not liable to get out of order. Owing to the fewness of the parts, it can be manufactured very cheaply. The bell can be attached to any wheel. A clamp secured to one of the front fork bars has a pivoted bracket carrying the gong, and a light wire passes from this bracket to the small thumb lever supported on the handle bar. A striking feature of the bell is a gong, in the form of a pyramid, being perfectly square in cross section. A gong of this shape necessarily presents four flat striking surfaces, which are engaged in rapid succession by the clapper at one end of a single rotatable spring striker arm. The spring striker arm is housed entirely within the gong and extends out longitudinally from it, being rigidly connected at one end to a short shaft joined in a bearing at the apex of the gong and carrying a small wheel adapted to be moved against the rim of the front bicycle wheel. A slight pressure of the thumb brings the bell into action by raising the entire bell and, consequently, the small wheel against the under side of the rim. This causes the wheel to rotate, working the striker arm and causing the clapper to strike upon the four surfaces of the pyramidical bell, giving a pleasant and continuous sound. The inventor is now prepared to consider propositions looking toward the purchase and working of the invention.

AN IMPROVED FURNACE.

Our engraving represents an improved furnace for heating purposes invented by Mr. Emory E. Starr, of



STARR'S FURNACE.

Bowling Green, Ohio. The object of this new improvement in furnaces is to make a furnace which shall be simple in construction, so that it can be manufactured at a minimum of cost, and to assemble the various parts of the furnace so that the air intended for heating purposes cannot be brought into contact with the products of combustion, and whereby the products of combustion are utilized to the greatest possible extent. In this furnace all the heating surfaces are brought into more or less direct contact with the air which is to be heated and supplied to the rooms or apartments. It will be readily seen that this arrangement tends to great economy in the consumption of fuel. The general arrangement of the furnace may be seen by reference to our engraving.

In operation, the fire door being closed, the air for combustion is conducted by a pipe and is admitted by a box on the front and passes by means of proper passages through the ashpit door or the slides therein, up through the bed of coals. The smoke and the products of combustion rise to the upper part of the fire-pot, which is closed with the exception of a damper in the middle, which normally closes a circular aperture. Near the top of the fire-pot are lateral openings into sub-flues which are connected at the bottom with other sub-flues. The waste products of combustion in a highly heated condition enter the sub-flues, pass through the said flues downward to the bottom of the fire-pot proper at one side of the fire-pot, and through the connecting flues to the opposite side of the fire-pot, where they pass out of the sub-flues through the offtake pipes under the dome by the medium of the upper branch pipe flues. The damper over the fire-pot is opened automatically when the fire-door is opened; the gases then proceed into the offtake flue without their being forced to follow the tortuous course described, so that the offensive smell of the gas when the door is open to attend to the fire is eliminated. The course of the products of combustion is shown by the arrows nearest the fire-pot, the vertical partition being broken to disclose the downward and upward travel of said products.

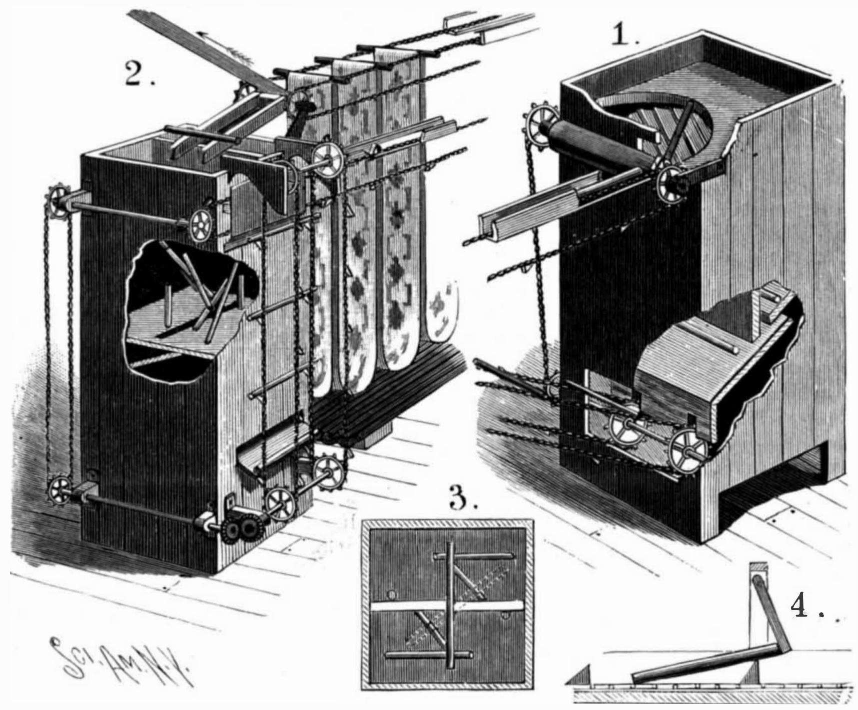
The air to be heated is taken in by a supply pipe at the back of the furnace near the top; the air is drawn down the outer flue, as shown by the outer arrow in our engraving. The air then enters the lower or base flue and then passes up through the vertical connecting flues, as shown by our second arrow, to the dome and thence to the supply pipe of the house or building. Thus it will be observed that the air to be heated is passed entirely around the cast portion of the furnace, for the fire-pot and the spaced outer wall should preferably be cast in one piece. This is the portion which is provided to absorb and radiate the heat, and finds an exit from the furnace in a highly heated condition.

A LATH CARRYING DEVICE FOR WALL PAPER AND OTHER MACHINES.

In manufacturing wall paper and other articles of a similar nature, it is customary to hang the paper or other articles upon laths in festoons to dry. In many cases the drying rooms are of great extent and it is necessary to return the laths after the paper has become dry to the point where the paper passes from the printing machine onto the sticking machine to be hung in festoons. This labor is usually performed by boys, who carry great piles of laths back to the front end of the striking machine. In doing this work they often break the laths, so that the festoons of paper are irregularly supported. The object of the machine shown in our engraving is to provide a new and improved lath carrying device, arranged in such a manner that the laths after leaving the sticking machine are automatically returned and fed again to the front end of the sticking machine to take up new folds of the paper. The sticking machine delivers a lath to the inclined chain carrier seen at the lower part of Fig. 1. This chain carrier takes a lath at certain regular intervals and carries it upward to the point where the paper from the printing machine falls on the lath, forming long festoons, as shown in Fig. 2, the horizontal conveyor chain then carrying both the lath and festoon forward toward the reels.

The return lath carrying device, shown in the accompanying engraving, includes a lath receiver at the rear or delivery end of the sticking machine to receive the lath from the latter. This receiver is so constructed (see Figs. 2 and 3) as to give the sticks a quarter turn while they drop downward in the end casing. The sticks then pass through a chute in the side of the casing and drop onto a chain elevator shown in Fig. 2, which carries the sticks upward and discharges the same into a horizontally disposed return carrier chain which moves the stick back to the receiving end of the sticking machine. At the forward end of the carrier the stick must be transferred in a lateral direction, so that it has to be turned. The device for this purpose is shown on the top of Fig. 1 and consists of a block having a curved edge adapted to be engaged by the end of the stick still pushed forward by the lug on the carrier chain, so that the stick moves transversely to the path of the chain, and finally it drops over the bottom having diagonal steps to bring the lath around to a transverse position. The lath then passes between two straightening rollers and finally drops down a chute back onto the inclined carrier chain of the sticking machine. Some of the sticks, when delivered by the elevator before mentioned upon the horizontal carrier chain, may drop onto the lugs thereof. In order to move the lath down onto the chain, the device shown in Fig. 4 is provided. This device consists of a gravity arm mounted to swing and extending with its lower free end into the trough of the carrier chain, so that a stick resting on a lug strikes against the said arm and is pushed by the latter off the lug as the chain moves forward, until the forward end of the stick drops off the advancing lug and then lies horizontally on the upper run of the carrier chain.

This very interesting and ingenious device has just been patented by John H. Suydam, Sr., of New Brunswick, N. J.



SUYDAM'S LATH CARRYING MACHINE.

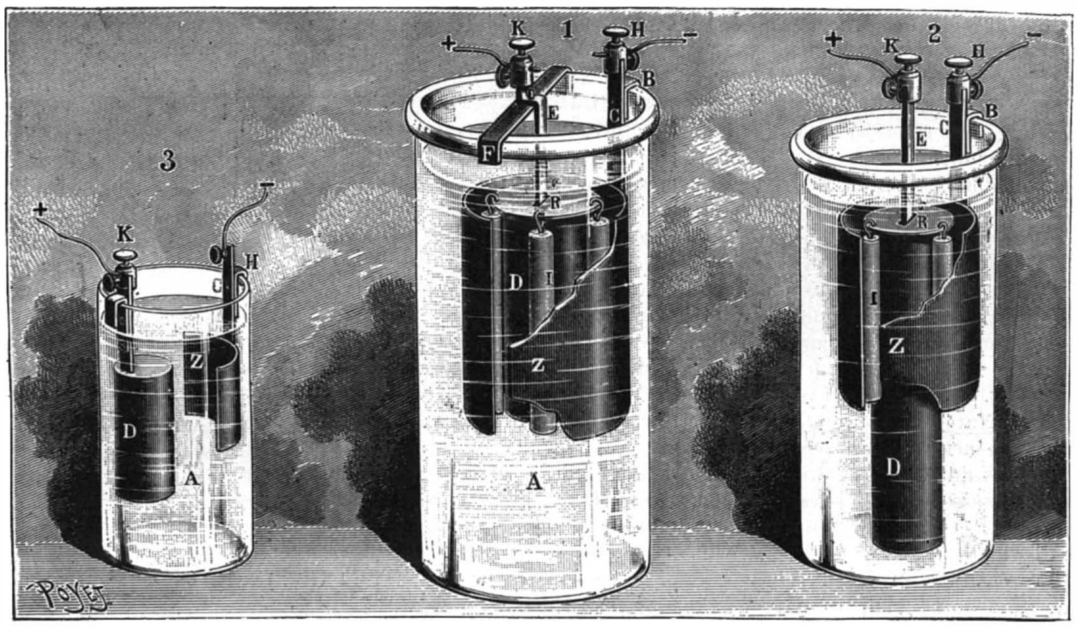
The Current Supplement.

The current SUPPLEMENT, No. 1166, contains many articles of more than usual interest. "How a Ship is Built" describes in detail the process of building a large ship in a German shipyard from the time the keel is laid down until she makes her trial trip. It is of great interest in view of the present war with Spain, as the building of some battleships and the famous liner "Kaiser Wilhelm der Grosse" are illustrated. "Spanish Naval Education" is another timely article dealing with the personnel of the Spanish naval officers and the methods by which they are educated. "The Working of Long Submarine Cables" is another article dealing with a subject of present interest, as the submarine cable is playing an important part at the present juncture. The wonderfully ingenious siphon recorder is fully described. "The Jubilee of Henrik Ibsen" deals with some of the works of this interesting personality, and is accompanied by his latest portrait. "The Psychology of Invention," by Prof. Josiah Royce, of Harvard, deals with the important and much neglected psychological side of invention. It is the second installment of a valuable paper. "The Protection of Industrial Property" is valuable to those interested in patents and trademarks. "The New Acetylene Generator" describes the latest French form, showing the application of acetylene gas for street lighting.

A PROOF that it is not always the sense of smell, but ofttimes that of sight, which directs insects to their flowers is noted by the distinguished French entomologist, M. R. Blanchard. A species of sphinx moth which entered a hotel room in the half obscurity of early morning was found to flit with direct intent to definite parts of the wall and ceiling. These were decorated with paintings of leaves and flowers, and to the latter the insect approached in repeated attacks, thrusting forward its proboscis as though intent upon intruding it into the opened cups of beguiling flowers. After repeated failures and the resulting discouragement, the effort was given up, and the moth escaped by the window. Another case of a butterfly which persisted in visiting the artificial flowers upon a lady's bonnet adds an instance to recorded facts of erring instinct among insects.

OXIDE OF COPPER BATTERIES.

The De Lalande oxide of copper battery, which is well known to electricians, is now widely used, and more than five hundred thousand elements have already been employed. This battery, in fact, does not wear away in open circuit and uses the products only in proportion to the energy furnished. It has, moreover, the advantage of giving a constant intensity.



NEW ARRANGEMENTS OF THE DE LALANDE OXIDE OF COPPER BATTERY.

The last styles of this battery contained a zinc electrode forming the negative pole, a disk of agglomerate of oxide of copper forming the positive one, and a 30 or 40 per cent solution of potassa. The generating reaction of the current is as follows: When the circuit of the battery is closed the water is decomposed. The oxygen proceeds to the zinc, which combines with the potash to form a very soluble zincate of the latter, while the hydrogen reduces the oxide of copper to the metallic state.

M. De Lalande, without changing the constituent elements of his batteries, has just introduced a certain number of improvements into their practical arrangements and a few simplifications that reduce the net cost. The oxide of copper is now placed in cylindrical boxes of perforated sheet iron and surrounded with a porous material of very feeble resistance. In this way deposits of copper upon the zinc are avoided. A few new arrangements have likewise been introduced into the form of the zinc. One of the principal peculiarities is the method of dissolving the potash. This product, placed in tin boxes, is, when the battery is in use, suspended from the top of vessels filled with water. The water enters these boxes, which are provided with a perforated bottom, and very quickly dissolves the caustic product. The result is the formation of a thick solution which falls to the bottom of the vessel. The liquid is then mixed and the pile is ready to operate.

The new arrangements adopted are shown in the accompanying engraving, which is reproduced from La Nature. In No. 3 is represented a small sized element of which the total height is 8 inches and the diameter 4. This style is capable of furnishing 75 amperes-hour. Its e. m. f. is 0·8 volt and the normal intensity is one ampere, but it is capable of giving from 2 to 3 amperes upon very feeble resistances. The zinc, Z, is suspended by a hook, H, from the edge of a vessel opposite the oxide of copper cylinder, D.

The style shown in No. 1 is the largest size. Its height is 14 inches and its diameter 7. It is capable of furnishing 600 amperes-hour at an intensity of from 5 to 6 amperes, and even a discharge of from 15 to 20 amperes. The zinc cylinder, Z, is suspended from the edge of the vessel, A, by a hook, B, and is provided with a strip, C, carrying a terminal, H. In the center there is an oxide of copper cylinder held at a distance from the zinc one by four porcelain insulators, I. The zinc cylinder is connected with a strip, E, which rests through an elbow upon a cross piece, F, and carries a terminal, K.

The medium sized battery represented in No. 2 has sensibly the same arrangements. The oxide of copper cylinder, D, rests here upon the bottom of the vessel. This element, which is 13 inches in height and 6 in diameter, has a capacity of 300 amperes-hour and is capable of furnishing from 3 to 4 amperes in a normal operation.

Such are the new arrangements of the De Lalande battery, in which the drawback to the use of potassa is greatly diminished by the recent improvements. It remains the sole type of a primary battery of large discharge that does not wear away in open circuit. All the parts are so calculated as to wear away at the same time.

This battery is much employed for actuating induction coils and for the ignition of gas and gasoline motors. One battery will actuate for a year an induction coil operating ten hours a day. It likewise renders great services in all cases where there is needed a source of feeble electric energy for constant or intermittent use.

AN ANCIENT CACTUS HEDGE.

BY C. F. HOLDER.

When, in 1771, the Spanish explorer Potola made his overland march from San Diego to Monterey, he determined to found a mission in the San Gabriel Valley. Despite the threatened hostility of the natives of the Indian village Sibanga, the mission of San Gabriel the Archangel was established in August of that year by Padres Cambon and Somero with a guard of twenty-one men.

This mission rapidly increased in wealth; but, the mission building being injured by an earthquake, it was deserted and replaced by another on a different location in about 1775. The mission became a power in the land and one of the most interesting in the remarkable ecclesiastical chain which tells the story of Spanish courage in this country.

It is interesting to note how the early Spaniards utilized the material of the country. One of the most striking instances is the old tuna hedge or fence which in early days entirely surrounded the San Gabriel Mission property, portions of which are intact to-day, and form a striking feature of the landscape in the vicinity. The hedge was planted by Father José Maria Zalvidea in 1806. The grounds of the mission embraced hundreds of acres, and owing to the hostility of the Indians, it was necessary to fence them in. Timber was very scarce, the only available material being the fine oak forest in which the mission was built, which gradually disappeared, probably as fire wood. Other timber was to be found only in the mountains, seven, eight or ten miles distant. Zalvidea had noticed the tuna, or Cactus opuntia, growing in great masses all over the country, saw that it was impenetrable and that its fruit was eaten by the natives; so he ordered the latter to collect and plant the cactus along the boundaries of the mission property. The opiny plant grew rapidly, and in a few years was an impenetrable chevaux de frise, a perfect fence and barrier which the domestic animals could not pass nor an invading foe easily cut down. To-day the remnant of the great hedge constitutes one of the historical points of interest in the San Gabriel Valley and is visited by hundreds yearly.

ANCIENT HEDGE IN CALIFORNIA.

The accompanying illustration shows several hundred yards of the old fence. Its height ranges from 6 to 10 feet, and it was probably higher when cared for by the natives of the mission. The original fence was undoubtedly several miles in extent, but has been broken by the passage of roads and streets, the disconnected portions being widely scattered but still vigorous, telling a most interesting story of the energy of the early settlers of the region. This cactus is one of the most economical hedges on a cattle range.

In this connection it is interesting to note the plants which are utilized in this way. The spiked leaves of the century plant are often employed. The plants are placed 4 or 5 feet apart, the leaves soon meeting and forming a hedge which is almost impossible to penetrate without serious injury. The name of this agave is a misnomer, especially in California, where it blossoms in from ten to twelve years, then dying down, the leaves falling away on all sides, deprived of life and vigor to supply the rapidly growing flower stalk.

In strange contrast to these warlike fences in California are the hedges of flowers found in the cities and towns. Thus one of the commonest hedge plants is the calla lily, which grows with the pertinacity of a weed and forms a beautiful hedge when in bloom. Geraniums and heliotropes are alone employed for this purpose. A fence or hedge of the latter on the island of Santa Catalina is nearly 5 feet in height, with woody matter sufficient to make it of value beyond a mere ornament.

Rose hedges of the rarest climbing roses are common everywhere in Southern California, those of the Cherokee and Gold of Ophir roses being especially beautiful when in bloom, the latter forming solid masses of color; while the Cherokee, with its broad-petaled white blossoms, presents a striking contrast against the glossy dark green of the leaves. The old tuna hedge will, in all probability, soon disappear. The gradual increase of population, the building of towns, will necessitate its removal, and thus one of the interesting landmarks of the country will have passed away.

The Identification of Our Soldiers.

A new plan has been adopted for identifying the men in the regular and volunteer United States armies who may go into action. They will wear around their necks little tags of aluminum, by which they may be identified if found on the field of battle. In the last war it was often impossible to properly identify the dead soldiers, and thousands were buried in graves marked "unidentified." The War Department has prepared this system of identification, and each tag will bear the numeral assigned each man on the muster rolls, with the letter of his company, battery or troop and his regiment.

IT takes 72,000 tons of paper to make the post-cards used in England each year.

The National Academy of Sciences.

BY MARCUS BENJAMIN, PH.D.

Notwithstanding the rumors of war and the hurrying of soldiers through our capital city, there was gathered two weeks ago a group of men who, in a quiet room of the beautiful Congressional Library building, in Washington, found time to discuss the various problems of their favorite sciences.

In this connection it is interesting to recall that just thirty-five years ago—on March 4, 1863—the National Academy was created. At that time Alexander Dallas Bache was superintendent of the Coast Survey and Joseph Henry secretary of the Smithsonian Institution. To these men and their associates was referred the very many propositions requiring a scientific solution that were submitted to the government. Finding that such work consumed so much of their time, a bill was introduced into Congress organizing the academy, whose function should be to act as adviser to the government on scientific matters.

The most important work of this character that it has been called upon to take up in recent years has been that of the forest reservations, and it will be remembered that, nearly two years ago, at the solicitation of the Secretary of the Interior, a National Forestry Commission was appointed by the academy to visit different parts of the United States and recommend that reservations of proper forest lands be made.

The stated session of the National Academy is fixed for the third Tuesday in April, and this year, as in years gone by, the academy met in Washington on April 19. Owing to the repairs that were being made in the National Museum, the lecture room in that building could not be procured, and so a meeting place was found in the library.

The scientific sessions, which are open to the public, are usually held after luncheon, and it is at such sessions that the scientific papers are read. A programme of twenty papers was presented at this meeting. Of these, three were by Alexander Agassiz, the director of the Museum of Comparative Zoology, in Cambridge. Dr. Agassiz has spent considerable time during the last year studying the coral reefs of the Pacific, and the results of his studies were given in a paper on "The Coral Reefs of Fiji," by himself, and two others, one in association with Mr. W. McM. Woodworth, on "The Fiji Bololo," and the other with Mr. A. G. Mayer, on "The Acalephs of Fiji."

Dr. John S. Billings, the director of the New York Public Library, found time from his arduous duties in connection with the supervision of the great libraries now under his charge to present a paper on "The Variation in Virulence of the Colon Bacillus," which is in continuation of the scientific studies that he pursued so long and ably while connected with the Army Medical Museum, in Washington, for so many years.

Dr. Theodore Gill, who presided over the meeting of the American Association for the Advancement of Science last summer, presented to the academy a biographical memoir of his lifelong friend Edward D. Cope, who had died since the last meeting of the academy.

Prof. Alpheus Hyatt, of the Massachusetts Institute of Technology, read a technical paper on "New Classification of Nautiloidea," which had to do with mollusks of the nautilus family.

Prof. Albert A. Michelson, of the University of Chicago, was present and described "A New Spectroscope." His researches on light are continued, notwithstanding the fact that his time is largely occupied with the duties of the chair of physics in the great university with which he is connected.

Prof. Ira Remsen, who is not only secretary of the academy, but also fills the chair of chemistry in Johns Hopkins University, presented four papers descriptive of work done under his direction in the Johns Hopkins laboratory. The first of these was "On Double Halides containing Organic Bases;" another was in association with Mr. E. E. Reid, "On the Hydrolysis of Acid Amides;" still another, in association with Mr. W. A. Jones, was on "The Question of the Existence of Active Oxygen;" while finally, with Mr. J. W. Lawson, he presented the result of studies "On the Product Formed by the Action of Benzenesulphonchloride on Urea."

The Johns Hopkins University was also represented by Prof. W. K. Brooks, who is connected with the natural history department of the university. His paper bore the title of "McCrady's Gymnophthalmata of Charleston Harbor," and was descriptive of certain kinds of jelly fishes.

Dr. Carl Barus, who fills the chair of physics in Brown University, presented two papers on his specialty before the academy. They bore the titles of "Ballistic Galvanometry with a Countertwisted Torsion System" and "A Curious Inversion in the Wave Mechanism of the Electromagnetic Theory of Light."

Among the representatives of the faculty of Yale University was Dr. Charles S. Hastings, who brought forward a paper entitled "A Consideration of the Conditions Governing Apparatus for Astronomical Photography." His associate in New Haven, Prof. Arthur W. Wright, described "A Method for Obtaining a Photographic Record of Absorption Spectra."

Among the astronomical papers was one on "Theories of Latitude Variation," by Mr. H. Y. Benedict, who was presented by Prof. Asa Hall, the distinguished discoverer of the moons of Mars.

Of similar character was that "On the Variation of Latitude and the Aberration Constant," by Charles L. Doolittle, who, not being a member of the academy, was introduced by Dr. Seth C. Chandler.

Another paper of an astronomical character was one by Mr. E. W. Brown on the "Progress in the New Theory of the Moon's Motion." Mr. Brown was introduced by Prof. Simon Newcomb, formerly of the United States Naval Observatory.

An exceedingly interesting paper on "The Use of Graphic Methods in Questions of Disputed Authorship, with an Application to the Shakespeare-Bacon Controversy," was read by Prof. Thomas C. Mendenhall, of the Worcester Polytechnic Institute. This was essentially a report of progress in which Prof. Mendenhall discussed his studies of the writings of Shakespeare by means of curves which showed the number of letters contained in words, and the corresponding proportion of words of a given number of letters in the writings of each of the persons mentioned.

Of less popular interest, although perhaps of more personal interest, was the election of new members to the academy. The election of foreign associates was first considered, and that honor was conferred upon the following:

Prof. Poincare, whose name is well known among mathematicians the world over; Prof. David Gill, the astronomer in charge of the observatory at Cape Town, Africa; Lord Rayleigh, the eminent English physicist; Lord Lister, the physiologist; Prof. Edward von Suess, the Vienna geologist; Prof. H. de Lacaze-Dutheirs, the Parisian zoologist; Prof. Strasburger, the great German botanist; Prof. H. Klein, of the University of Göttingen, Germany; Prof. Henri Moissan, the great chemist of Paris; and Prof. Karl von Zittel, the distinguished paleontologist of Munich, Germany. The election of the foreign associates was followed by the election of a treasurer for the academy, Dr. Billings having resigned on account of his removal from Washington. Mr. Charles D. Walcott, director of the United States Geological Survey, was elected in his place for a term of six years. All of the present members of the council were re-elected for the coming year. They are: J. S. Billings, H. P. Bowditch, G. J. Brush, A. Hague, O. C. Marsh and S. Newcomb. The officers of the academy are members of the council ex-officio.

It is very much to be regretted that the academy were unable to decide upon any of the numerous candidates that were presented before them for election. The membership in recent years has met with serious losses owing to the death of many of the early members, so that to-day Dr. Walcott Gibbs, president of the academy, the venerable James Hall, Prof. J. P. Lesley, director of the State Geological Survey of Pennsylvania, and Fairman Rogers, are the only surviving original members. That such eminent scientists as David A. Wells and Edward Atkinson among economists, David Starr Jordan and Henry F. Osborn among naturalists, Daniel G. Brinton and Franz Boas among ethnologists, and William Harkness and James E. Keeler among astronomers, are not admitted to the academy is a most unfortunate fact.

The death of Prof. William A. Rogers, of Colby University, was announced to the members, and the autumnal meeting of the academy was recommended by the council to be held in New Haven, Conn.

The Audibility of Thunder.

While lightning may be seen and its illumination of clouds and mist may be recognized when it is even 200 miles distant, thunder is rarely audible more than ten miles. The thunder from very distant storms, therefore, seldom reaches the ear, says Industries and Iron. The reason of the great uncertainty in the audibility of thunder is not difficult to understand. It depends not merely on the initial intensity of the crash, but quite as much on the surroundings of the observer, even as in the quiet country one will observe feeble sounds that escape the ear in a noisy city. Perhaps the most curious and important condition of audibility is that the thunder wave of sound shall not be refracted or reflected by the layers of warm and cold air between the observer and the lightning or by the layers of wind, swift above and slow below, so as to entirely pass over or around the observer. Sound, in its wavelike progress obliquely through layers of air of different densities, is subject to refraction, and this refraction may occur at any time and place. Thus, observers at the topmast of a ship frequently hear fog whistles that are inaudible at sea level; those on hilltops hear thunder that cannot be heard in the valley; those in front of an obstacle hear sounds inaudible to those behind it. The rolling of thunder, like that of a distant cannonade, may be largely due to special reflections and refractions of sound. Again, the greater velocity of the air at considerable altitude above the ground distorts the sound wave and shortens the limit of audibility to the leeward, while increasing it to the windward.

Miscellaneous Notes and Receipts.

Production of Lac-varnish.—The alcoholic solutions of shellac and other resins are known to be decomposed into various constituents by the addition of water, a part separating as precipitate. In order to accelerate the separation of the precipitate, an acid may be added to the alcoholic resin solution mixed with water. According to a German patent, this precipitate is filtered off from the solution and dissolved in benzine, benzole, etc.; this solution represents the varnish. The lac-varnish prepared in this manner possesses the advantage of giving a rather dull surface after drying, and is therefore especially adapted for the production of washable wall paper.—Chemische Revue.

In the production of extremely thin leaflets of metal, the gold beaters generally subject the gold to hammering between two sheets of parchment. But with this treatment there is a limit as regards the thickness of the leaflets, since the mechanical production requires a certain resistibility of the object. In order to produce very fine leaves, the galvanoplastic process is now employed. A very thin plate of smoothly polished copper is immersed in a suitably prepared bath, from which, on closing the current, gold is precipitated on the copper. To remove the copper the double leaf of metal is immersed in a solution of chloride of iron, which loosens the copper completely, but leaves the gold leaf, which has a thickness of one ten-thousandth of a millimeter, untouched.—Die Mappe.

Graphite as a Lubricant.—The use of graphite as a lubricant is now recommended even by the organ of the Prussian steam boiler inspection society. An important condition, however, is that the graphite must not only be free from all hard foreign bodies, such as quartz, but also be in the shape of flakes, which cling to the rough surface of the metal and fill up all irregularities left in the manufacturing. Such graphite, if used alone, is, according to recent experiments, three times as effective as the best mineral sperm oil, and in the case of simultaneous employment of a like quantity of lubricating oil, six times as efficacious. According to the Hannov. Gewerbeblatt, Prof. Kingsburg is said to have found that while heavy mineral oils showed a coefficient of friction of 0·14, the same volumes of oil with graphite had one of only 0·07. In the necessary flocculent form, which is the product of a doubtless expensive chemical treatment, graphite is at present only placed upon the market from two places, viz., from Ceylon and from Ticonderoga, in the State of New York.

Something New Regarding the Potato.—One would imagine that science could not furnish us with anything new in our daily foods, but it is a remarkable fact that our food potato has not been sufficiently examined from a scientific standpoint, while greater attention has been paid to the varieties of potatoes employed for industrial uses.

The French chemist Balland has striven to fill this void in an essay presented to the Paris Academy of Sciences, divulging many interesting characteristics of the potato used for food. Aside from the skin, which only represents a small fraction of the total weight, the potato consists of three layers, well distinguishable with the naked eye if a thin slice is held against the light. Still more distinctly these three layers become visible if photographed with the Roentgen rays. The strata are of different thicknesses, which decrease toward the interior. The outermost layer contains comparatively the most starch, but less nitrogenous substances; with the innermost layer the proportion is just the reverse. The middle layer has a mean composition between the two others. The skin layer is the driest, while the inside marrow contains considerably more water. On an average a potato contains three-quarters of its weight of water, two-tenths of starch and one-fiftieth of nitrogenous matters. Balland has discovered the important fact that the food value of the potato is so much greater, the more nitrogenous substances it contains, and so much smaller, the richer it is in starch. In the best table potatoes the proportion between nitrogenous matters and starch attains three times as high a value as with the food potatoes of the lowest quality. Hence the value of a potato can be ascertained by a chemical analysis; but it so happens that the food value of different varieties of potatoes can be judged according to their behavior when boiled. We all know that some potatoes swell up in hot water, cracking in certain places and even breaking apart, while others retain their original shape, even when well done. It was supposed, formerly, that the cracking or breaking apart of potatoes was indicative of an especially large percentage of starch, the starch swelling up and breaking the skin According to the latest investigations this is erroneous, the percentage of albumen being responsible. If a potato is comparatively rich in this substance, it will keep its shape on boiling; a cracking and falling apart indicates a deficiency of albumen. The potatoes containing most albumen being the most nutritious, everybody can determine the worth of a potato by boiling it. The best varieties are those which do not fall apart, but remain whole, on cooking.—Staats Zeitung.

THE WASHINGTON, D. C., NAVY YARD.

On the 25th of February, 1799, the United States Congress appropriated $1,000,000 for the building of six ships of war of the largest size. The Navy Department having in mind the creation of a permanent navy bought, in the latter part of the same year, ground for six navy yards—at Portsmouth, N. H., Boston, Mass., New York, N. Y., Philadelphia, Pa., Washington, D. C., and Norfolk, Va. The Washington yard is situated on the banks of the Eastern Branch of the Potomac River. It is now principally devoted to the manufacture of ordnance. Only one ship was ever built in it, and no ships as a rule lie at its wharves and bulkheads. The buildings were destroyed by fire on August 22, 1814, on the approach of the British, under General Ross. Two years later they were rebuilt and the yard once more was in running order.

During the Civil War, ships were repaired and refitted in the yard, and ordnance and ordnance stores were dealt with. By order of Secretary Whitney, dated April 14, 1886, the yard was transferred to the care of the Bureau of Ordnance. It now has a $2,000,000 plant for manufacturing ordnance. The gun shop is considered the best equipped in this country, and perhaps in the world.

The yard is entered through an archway which passes through the marine barracks. This body of naval troops, whose merits, discipline and services have so often been acknowledged and commented on, have one of their principal stations here. The first illustration shows their barracks as seen from within the yard. The wide avenue, like the rest of the thoroughfares in the yard, named after a distinguished naval officer, runs right through the yard almost to the river's edge, terminating at the commandant's office. In the cut at the lower left hand corner of the first page of this issue, the commandant's office is seen in the distance at the extreme end of Dahlgren Avenue. More than thirty naval officers have successively been in command of the Washington Navy Yard. Rear Admiral Norton is now in charge, an officer of forty-seven years' service, who entered Annapolis in 1851.

A squad of the marines drilling forms the subject of one of the cuts. Great attention is being given to the arming of the corps. The most improved small caliber low trajectory rifle has been selected by the department for this service.

Recurring to the first cut, a flag staff is seen rising in the center of the line of Dahlgren Avenue. The same flag staff is seen in the other view of the same avenue. Near its base hangs the well known yard bell. On this are sounded at half-hour intervals the ship's bells, one bell to eight bells, in regular nautical fashion, for the twenty-four hours of each day. The bell is one of the minor though interesting features of the yard.

As the visitor passes down Dahlgren Avenue he has the gun shops on his right, a small wooden stairway taking the visitor into the building. We have recently described in some detail the process adopted for manufacturing guns, and have given, in former issues, several views taken in the gun shop.

The gun shops are in charge of Commander Edwin C. Pendleton, whose portrait will be found on the front page. He entered the service on October 10, 1863, received his commission as commander March 21, 1897, and was assigned to duty as superintendent of the gun shop on May 31, 1897. He is an important factor in the present war, so much of his work having been devoted to the finishing of guns now in place on the ships in service in the present war.

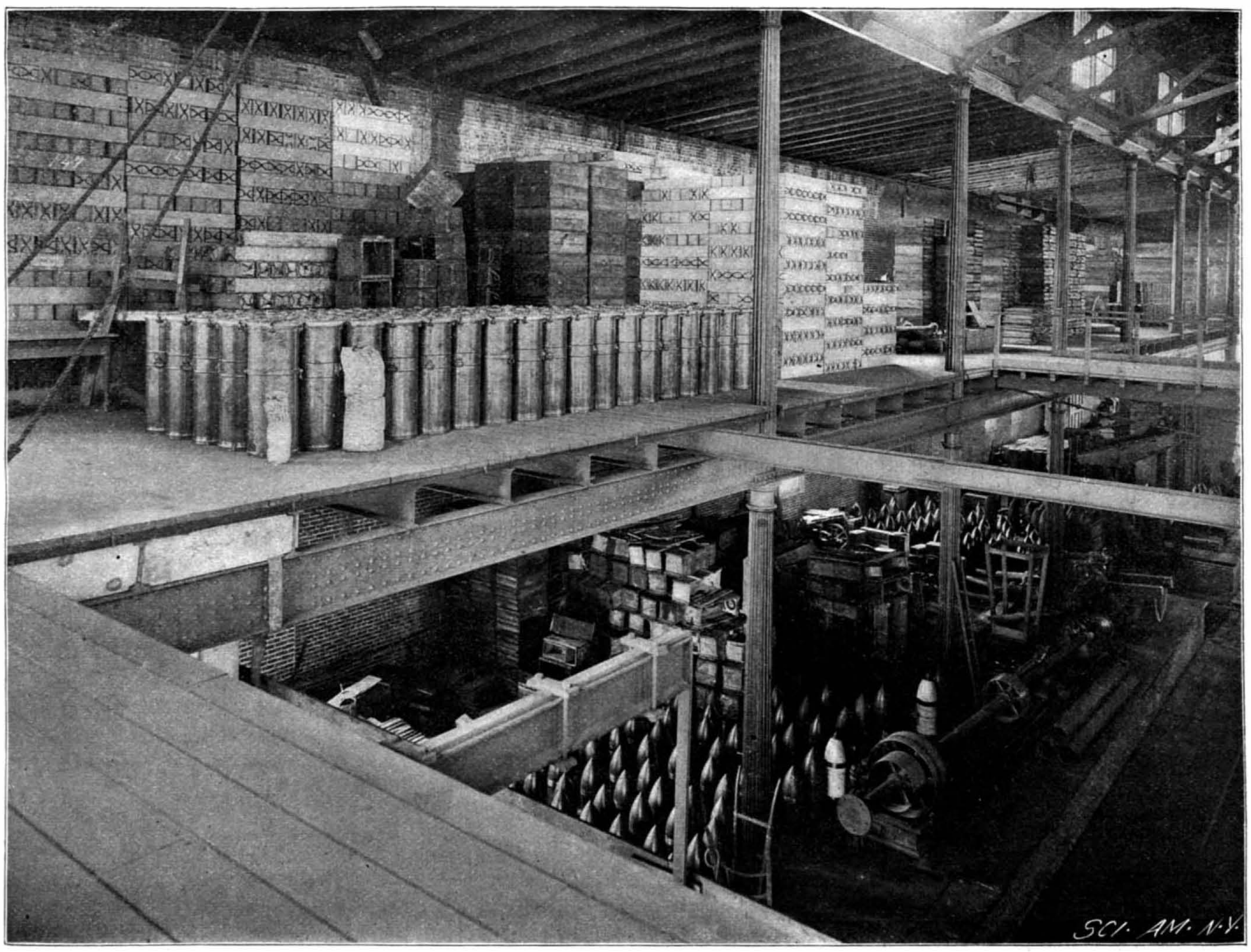
On this page we also give a view of the ammunition stores, in which are stowed away the powder, projectiles and cartridge cases for the guns. On the lower floor are seen 6-inch, 8-inch and 10-inch shells, the larger ones in the background. At the present day solid projectiles are not generally used for heavy ordnance.

The utmost refinements in design, manufacture and composition of the steel are applied in the making of shells. A single armor-piercing shell for the 13-inch gun costs nearly $600.

On the upper floor of the ordnance storage building are seen a number of rectangular boxes. Each of these contains ten cartridge cases for 4-inch and 5-inch guns. The cylindrical boxes standing on the floor are powder cases, such as used for large guns. They are made of copper with waterproof lids and joints. The brown powder used in heavy guns is put into sacks, a couple of which are shown by the side of the cylindrical tanks. After they are filled the sacks of powder are kept in the tanks.

The 13-inch gun is the largest size made for naval use. Such a piece weighs 137,000 pounds and lacks one inch of being forty feet long. It discharges a projectile weighing 1,100 pounds, and its charge of brown powder weighs 550 pounds. Such a shell will penetrate nearly two feet of steel at a distance of one mile from the gun.

The extreme ranges of guns are estimated on a rough basis of one mile to each inch of diameter. Thus the 13-inch gun is credited with a range of thirteen miles. These extreme ranges are not likely to be used in practice, so the statement of their length is rather in the nature of a concession to popular interest.



ORDNANCE STORES—WASHINGTON D. C. NAVY YARD.

The cylindrical powder tanks shown in the cut are for 10-inch gun charges, and are of special interest as being identical with those on the "Maine." Two hundred and fifty lb. of powder is required for a charge for the 10-inch gun, and the 500 lb. projectile is capable of piercing about 16 inches of steel at a distance of a mile. This is the type of gun which was on the "Maine."

In old times when guns were abandoned they were rendered useless either by driving a file or hard steel plug into the vent, or by inserting a plug far down into the bore. This plug was so constructed as to jam itself more firmly with every attempt to withdraw it. On abandoning guns of the present type, they can be dismantled by carrying off the breech mechanism. This it is reported was done in the case of the "Maine."

The lower right hand cut shows the experimental model tank. In spite of all the refinements of modern mathematics, the designing of ship models is far from being an exact science. The abandonment of old theories with regard to the preponderating influence of certain factors in the production of fast models and the acceptance of the theory of skin-friction have undoubtedly simplified the problem. But after all it remains to a considerable extent a matter of trial. The results of a specified model cannot be predicted with certainty—the model has to be tried.

Already very extensive trials of shapes of vessels have been made in various countries by the use of small models. These may be towed through still water and the force required to propel them may be determined by a dynamometer, or the models may be kept stationary in a stream of flowing water and the stress determined. To observe the action on the water of the passage of the vessel, threads held at one end and immersed in the water near the model take a position coincident with the direction of the currents due to the motion of the model, and show the deflection of the water. The threads act like long flags or streamers in a breeze.

The models have been variously made. Paraffin wax has been one of the favorite materials. It can be cast of the desired shape and can be modified by cutting down or building up until the best shape is experimentally determined.

The establishment of a model testing tank is under the charge of the Bureau of Construction; it indicates a return to a certain extent to the original functions of the yard.

The illustration shows in the foreground the end of the tank from which the models are to be started. The tank is built of concrete and is 470 feet long. The water is to be spanned by a moving bridge running on a railroad the length of the tank. The models will be towed through the water from the bridge, the towing mechanism being operated by electricity. Dynamometers will indicate the pull required to draw the models along at speeds accurately regulated and measured by the apparatus. A building 500 feet long and 50 feet wide is to cover the tank. Perfect quiescence of air and water are thus to be insured. From data ascertained with models, perhaps 15 or 20 feet long, operated at slow speed, data for full sized high speed vessels may be deduced.

The tank has to have a relatively large depth and width to prevent the waves generated by the motion of the models from interfering with the results. An actual ship generates waves under al' conditions of motion and depth of water, but their effect on her progress is greatly dependent on the body of water in which she moves. In shallow water the waves are modified by the bottom and the vessel goes slower. In a high speed ship of large size, very deep water is required to enable her to develop her full speed. The relatively slow speed of the models in the model tank will eliminate this influence, as the wave factor will be diminished in relative importance by the slow motion.

The tank was designed by Naval Constructor D. W. Taylor, who is superintendent of its construction also. It will supply data much needed in the present time, when high speed is so important a quality in ships of war.

To Watch Plants Grow.

To observe plants growing under the microscope, The American Monthly Microscopical Journal says: "Procure a little collomia seed. Take one of the seeds and with a razor cut off a very tiny slice, place it on a slide, cover with a cover glass and place under the microscope. The instrument must be in a vertical position. When it is well focused and lighted, moisten it with a drop of water. The seed will absorb the moisture and throw out a very large number of spiral fibers, giving the appearance of veritable germination. Beginners will find it easier if one applies the moisture while the other looks through the instrument."

A CURIOUS accident was reported from Dayton, O., recently, in which water caused a fire. The Craig-Reynolds shops in North Dayton were flooded with ten feet of water, which reached some packages of carbide of calcium. This formed acetylene gas, causing several explosions and a fierce blaze. The fire department had to fight the flames from boats. The damage was $10,000.

RECEIVING SHIP "VERMONT."

At the end of the official lists of the vessels of the United States navy will be found a table with the heading "Wooden sailing vessels, unfit for sea service." It includes the names and particulars of some half dozen veterans—relics of the days of sail power and the smoothbore—the most youthful of which, the "Dale," built in 1839, is in its sixtieth year, and the oldest, the glorious old "Constitution" (1797), has entered the second century of its eventful career. Two of the ships, the "New Hampshire" and the "Vermont," are twins. They left the cradle in the year 1818 and are, therefore, in their eighty-first year. They are by far the largest vessels on the list, having a displacement of 4,150 tons, or nearly double that of the "Constitution," whose displacement is 2,200 tons. Both are stationed at New York, the "New Hampshire" near the Twenty-third Street ferry, on the East River, and the "Vermont" at the Brooklyn Navy Yard, the former being used by the State naval militia and the latter doing duty as a receiving ship.

The "Vermont" was a first-class line-of-battle ship of the type in vogue in the early years of this century, and by comparing her hull, with its lofty topsides, with a modern battleship like the "Indiana," we get an impressive idea of the vast changes which have been wrought by the introduction of steam into the navy. If a visitor should chance to be at the Brooklyn Navy Yard when one of the latest steel warships is lying within a stone's throw of its wooden prototype, he will find it difficult to realize that such ships as the "Indiana," the "New York" or the "San Francisco" have been evolved out of the clumsy old hulk which now does duty as the receiving ship of the yard.

If the reader would reconstruct the "Vermont" in his mind and recall her as she appeared in the days of her glory, he must first strip off the unsightly roof and the upper tier of windows and side walls. These have been added to provide a covered deck for exercise and instruction, and they formed no part of the ship as first built. The line of the original bulwarks can be seen starting at the top of the figurehead and running clear to the stern. About six feet below this line is the spar deck, or upper deck, as it is sometimes called. Like the other three decks of the ship it is flush throughout, the forward part of it in the bows being known as the forecastle, the after part, astern of the mizzenmast, being the quarter deck. Above the quarter deck was a raised deck called the poop, sacred to the admiral, captain and chief executive officers of the ship. Beneath the spar deck is the upper gun deck, and below this again are the lower gun deck and the berth deck. The spar deck and the two gun decks are pierced by square portholes, as shown in the engraving, and from each of these protruded one of the many guns with which the "Vermont" fairly bristled. Judging by the number of portholes, she must have carried about 100 guns, and these would range from the 12-pounders up to the 32-pounders, all, of course, being smoothbores.

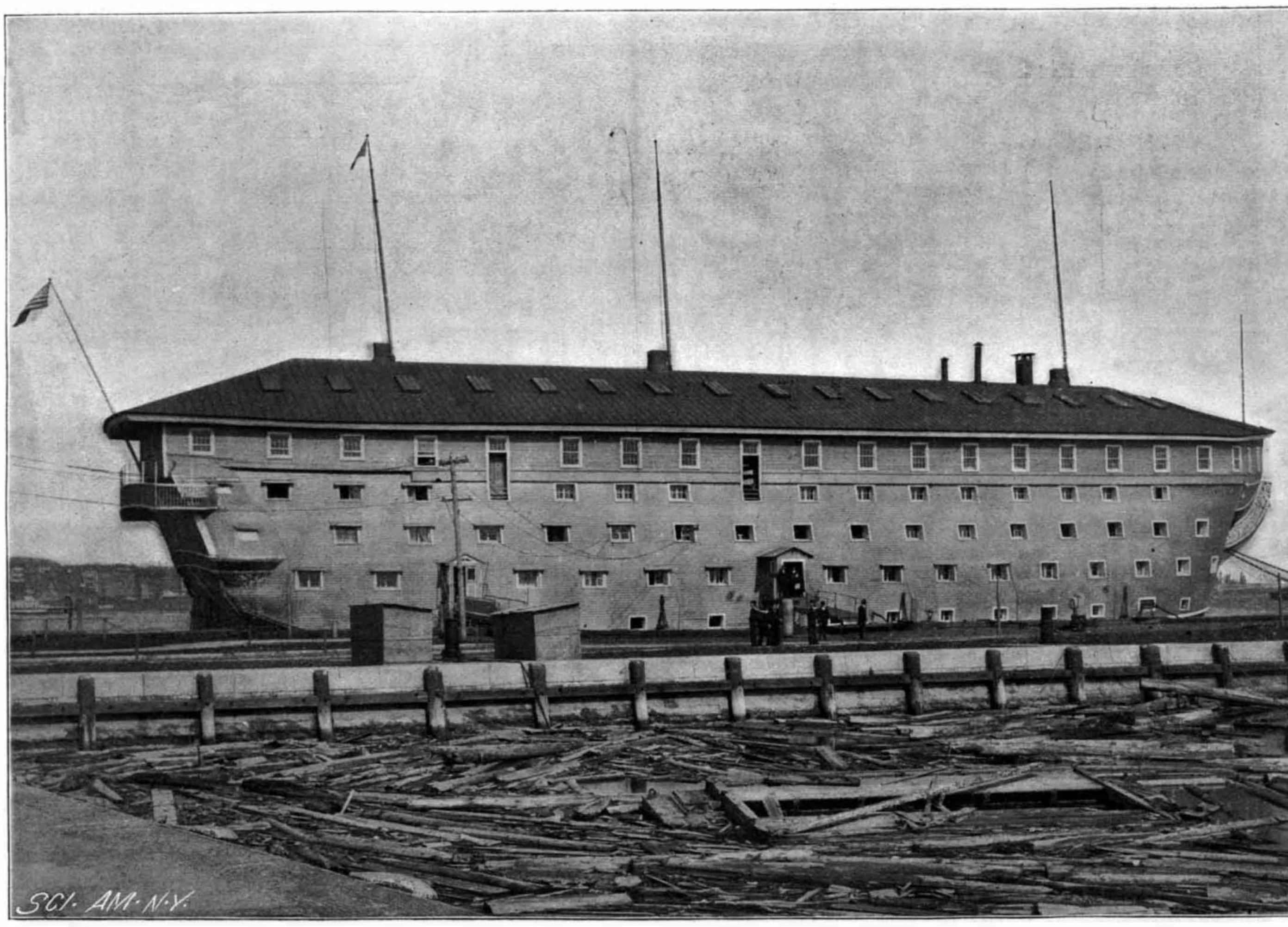
Although the dismantled hull of the "Vermont" appears clumsy and devoid of any lines of beauty, when she was fully rigged in all the glory of her long yards and lofty masts she must have been an imposing spectacle. A great three-decker like this was masted and sparred on a scale that is never seen in our merchant marine. It was no uncommon thing for the main yard to be from 100 to 120 feet in length, and the topsail and topgallant yards were in proportion. In those days the sail maker and rigger knew nothing of the convenience of upper and lower topsails—the whole stretch of the topmast intervened between the single topsail yard and the main yard, and the huge single sail forms a conspicuous feature in the representations of a line-of-battle ship of those days.

The stumps of the fore, main and mizzen masts are still standing in the "Vermont" and the tops of them may be seen protruding above the roof at the base of the flag staffs. The captains of those days sailed their ships hard and were wont to carry a heavy press of sail when it was blowing "great guns." Standing and running gear, masts and yards had to be stout in proportion; and if the stump of the main mast is any criterion, the "Vermont" must have been nobly sparred. The mast is over 4 feet in diameter and is built up of a central stick 3 feet in diameter, reinforced by four vertical stiffening pieces 4 inches thick by 16 inches wide, evenly spaced around the core and firmly held in place by shrinking on ½-inch by 5-inch iron bands.

On entering the between-decks one is impressed with the wonderful strength and solidity of the construction, an impression which is confirmed by the fact that the frame of the ship is built of live oak and the decks and planking of the best yellow pine, the vessel being copper fastened throughout. The ribs and deck beams are of bulky dimensions, the latter in the spar deck being 10 by 14 inches and still heavier in the lower decks. The sides are fully 2 feet thick and they are strengthened and stiffened in all directions by stout copper clinched oak knees. The decks and walls are, indeed, extraordinarily heavy, and when we remember that a hundred guns, worked by a thousand brawny tars, were wont to roar out their broadsides by the hour, and that this was liable to be accompanied by the crashing and rending hail of twice one hundred round shots of the enemy, it can be understood that the work is none too strong.

The "Vermont" in her present capacity as receiving ship serves as the temporary home of crews whose ships have gone out of commission or who are being transferred from one ship to another. The length of a seaman's stay varies from one night to a week or more. The deck beams on all decks are provided with hammock hooks, and there is berthing space for a thousand men. The berth deck is used as a mess room. There are 32 tables, each seating 16 men.

During the present war the "Vermont" is doing duty also as an enlisting station. The recruits are exercised in the "setting up" drill and each man is provided with his full outfit, including bag, hammock, clothes and all the etcetera (not very numerous) which are indispensable to the modern Jack Tar.



THE OLD THREE-DECKER LINE-OF-BATTLE SHIP "VERMONT," NOW RECEIVING SHIP AT THE BROOKLYN NAVY YARD.

Length between perpendiculars, 196¼ feet; beam, 53 feet; draught, 25½ feet; displacement, 4,150 tons; speed, 10 knots; original complement, 1000 men; built, 1818.

THE Surgeon-General of the Army has placed with certain instrument makers of New York City large orders for capital and minor operating cases and other apparatus. One firm received an order for 950 probes and 500 field tourniquets. Adhesive plaster has been ordered up to nearly 4,000 yards, and 2,000 spools of antiseptic ligatures.

Curiosities of Filtration.

In Sir E. Frankland's annual report on metropolitan water just published by the local government board some very curious details may be found in regard to the results of the filtration to which London water is subjected, all of which tend to support the statements recently made by the London Hospital as to the extreme variability of the filtered product. Take, for example, the West Middlesex, which month after month supplies its customers with water of a high degree of purity, containing on one occasion only four microbes per cubic centimeter and on another appearing to be absolutely sterile. Of what advantage, however, is this if, on another occasion, the number mounts up to 120, and on still another to 576 microbes per cubic centimeter? Something happened in the month of June to nearly all the filters.

"Of the five companies drawing from the Thames, all except the Southwark were smitten with this microbial epidemic in June, and even the Southwark had got it on the 2d of the following month. Of the two companies drawing from the Lee, the New River alone escaped." So serious was the condition that, from the tables given to show the reduction of micro-organisms by filtration alone, we find that in one case 66·3 per cent of the microbes passed the filters.

Lest, however, we should be tempted to cast ourselves upon Providence in these matters, and think that this "microbial epidemic" was some widespread fatality that no company could escape from, it is worth while to look further into the matter, when we find that where separate filter beds were separately examined, as we have maintained ought always to be done, a very great difference was demonstrated in their activity.

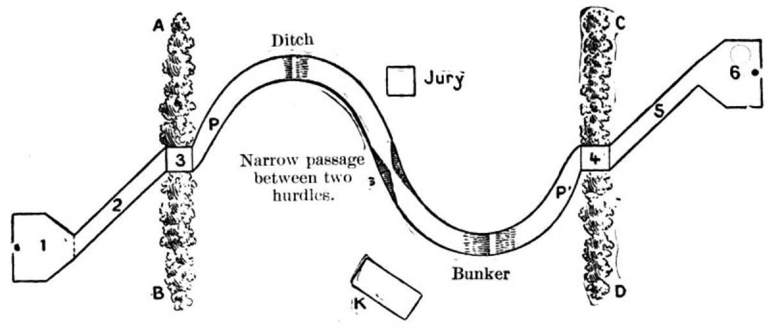
While one of the Grand Junction filters was passing sixteen and another fifty-six microbes per cubic centimeter, another was passing 1,080! What this has to do with the construction of the filters and what can be done to improve them is another matter; but Sir E. Frankland seems to be on the right track when he draws attention to "the enormous advantage of fine sand in securing efficient filtration." Some companies go to the trouble of using much finer sand than others with apparently good results. "Thus: 1·8 feet of the fine sand of the New River Company and 2·75 feet of that of the West Middlesex Company are respectively more than twice as efficient as 4 feet of the coarser material used by the Chelsea Company."

The Marking of Imported Goods Bearing Registered Trademarks.

The Assistant Secretary of the Department of the Treasury has just issued a circular to collectors of customs by which the Department Circular of February 14, 1898 (synopsis 18963), has been modified in accordance with the advice of the Solicitor of the Treasury so as to allow the importation of articles stamped with a registered trademark, although such trademark may consist in part of the name of a city, county, or State in this country, provided that such trademark shall have been duly registered prior to the date of this circular, which is April 8, 1898, and that the evidence of such registry shall have been duly filed in the treasury department. In such cases, however, the words "made in Germany" (or other country of production) must appear on the same surface with it and in close proximity to the said trademark. The address of an importer or dealer in this country who is not a manufacturer may likewise appear under the above named conditions.

COMPETITION OF SHEPHERDS' DOGS AT ANGERVILLE.

The question of the improvement of the French shepherd's dog was raised two years ago, and, thanks to the initiative of M. Emmanuel Boulet, founder and president of the French Shepherds' Dog Club, was made the order of the day. M. Boulet saw himself at once seconded by the sympathy of the minister of agriculture and supported by the entire agricultural press.



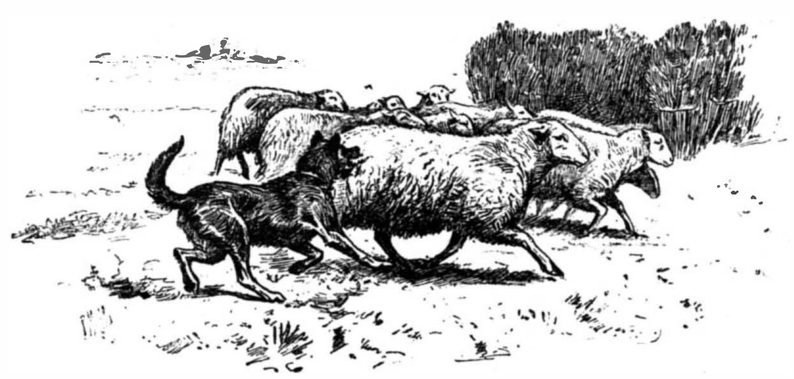
1. Sheep Fold. 3. Starting Platform. 4. Platform at the Finish. 6. Receiving Fold. K, public tribunal; A B C D, lines of shrubs.

BEAUCE DOG.

BRIE DOG.

The club now has numerous adherents, and it is with pride that the shepherds and drovers say to you : "We are members of the club."

The dogs that are so useful for guarding and driving flocks were soon submitted to competition, not only from the standpoint of breed and beauty, but also on the ground in the form of special tests.



IMPROPER MANNER OF TURNING ASIDE A SHEEP.

PROPER MANNER OF TURNING ASIDE A SHEEP.

The first races, if we may so express ourselves, took place with success in the vicinity of Chartres, last year. The result obtained led the club to organize the Angerville races, which were run on Sunday, May 30. In this land of Beauce, with its immense plains, shepherd's dogs are numerous, and the drovers also have their contingent of very stylish animals.

The train took us at ten minutes to nine to the Angerville station, where the Orphic Society of the place came with great pomp to meet M. Menault, inspector general of agriculture and mayor of Angerville, surrounded by the organizers of the contest, Messrs. Boulet, Tisserand, Sevrette, Bodmer, Masson and others.

In front of the mayor's office there was a drawing of numbers by lot, and the number of each dog was carried by the shepherd upon an armlet.

The animals presented were judged from the view point of beauty of breed, and then everyone went to breakfast. At half-past twelve a start was made from the mayor's office for the field of tests, two gendarmes, on horseback, heading the procession, followed by music with a banner at the head. Behind came the spectators and the contestants and the dogs, held by a leash by their masters. The plan of the track will give the aspect of the competition better than words.

The path to be taken by the sheep was indicated upon the plain only by two furrows made by a plow and staked out by small poles here and there, provided with a tricolored pendant. A strong, cool breeze was blowing that made all the flags wave and the canvas of the tribunes flap. The weather was splendid and the sun hot.

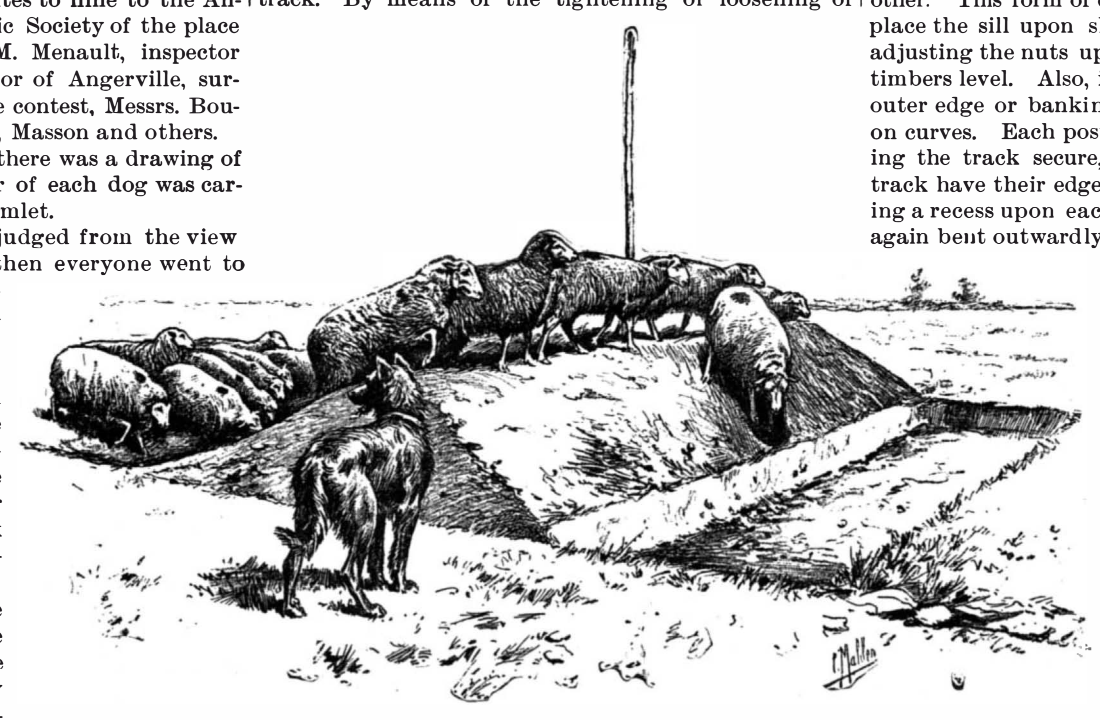
The competition began. In the stock fold there was a large flock of sheep to be used for the occasion. Each shepherd was to drive a flock of fifteen sheep from point 1 to point 6, without the dogs allowing the animals to stray from the road between the two furrows. The flock had to surmount obstacles, ascend embankments, redescend into ditches and pass between hedges that formed a narrow passage; and all this in close groups without any of them separating.

Incidents were not wanting. Out of the thirty-two dogs registered, very few led their sheep from one fold to the other without a hitch. Gallops in disorder across the field and between the legs of the spectators made the public merry. More than one shepherd, tired of the obstinate resistance of the sheep to obstacles, seized the leader of the flock from the lot, and, holding him firmly by the nape, dragged him over the embankment and thus made himself followed by the band of imbeciles. We more than once saw the history of Panurge renewed during the course of these tests.

The good dogs were the ones which, not becoming enervated, led their animals judiciously. They took a little more time for the operation, but prevented disorder in the ranks.

The good shepherd's dog should not seize the sheep by the rump, where a wound by his fangs might spoil a leg of mutton, the essential part in butchery, but rather by the nape.

After the tests in driving, the sheep were placed in hurdles, for the competition in placing and separation of lots.—L'Illustration.



THE PASSAGE OF AN EMBANKMENT.

An Adjustable Bicycle Racing Track.

A resident of Newburg, N. Y., has devised what he styles an adjustable track. Portable would probably be a better word. It is composed of metal and wood, and has an arrangement for regulating the pitch of the banking to suit the speed requirements of the track. By means of the tightening or loosening of bolts, the course can be made flat or almost vertical, as may be desired. In addition to this advantage, a number of steam pipes run around the course, so that if used for out-door racing in winter time, by a circulation of steam or hot water all of the snow and ice on the track can be melted, and the track kept clear. Furthermore, the track can be taken down and put up whenever desired, and the same grounds can be used for other purposes.

The construction of the track is described as follows, says The Evening Post. The metal plates are first placed upon the ground, extending across the course of the track. These plates act as sills for carrying the weight of the track, and are placed at distances apart along the course of the track equal to the length of the plates of which the sections are composed. These plates are formed with holes in their centers or notches extending from the edge to the center. The notches receive the vertical posts, which support the cross-timbers carrying the track. These posts have screw bolts, and can be adjusted so as to support the cross-timbers at greater or less elevation, and when necessary to raise one end further above the sill than the other. This form of construction makes it possible to place the sill upon sloping ground, and by properly adjusting the nuts upon the posts making the cross-timbers level. Also, in cases where it is necessary, the outer edge or banking of the tracks may be elevated on curves. Each post is driven into the ground, making the track secure, and the plates which form the track have their edges bent upward and inward, forming a recess upon each side. The edge of the plate is again bent outwardly, forming an outer recess, within which is placed the steam-pipe. Within the recess which is inside the trough formed by the upturned edges of the plates, vertical braces are placed at suitable intervals. This serves to stiffen the vertical portion of the plate and makes the track stronger than it otherwise would be. Provisions have been made for locking the devices at each end of the plates which are fastened to the cross-timbers. Upon the side of the cross-timbers are fixed two offset plates. The ends of these are slightly separated, and behind the offset portions form a recess receiving another plate.

ENGLISH ENGINEER'S ANALYSIS OF SQUADRONS OF SPAIN AND UNITED STATES.

The London Engineer is responsible for the comparison between the Spanish and United States navies published herewith.

"As the effective components of the two squadrons now facing one another in West Indian waters are considerably modified by the completion and purchase of additional vessels, their relative forces have been correspondingly changed since we last described them. The accompanying diagrams denote precisely the existing condition of the two groups of battleships, armored cruisers, and protected vessels which are of recent type, it being assumed that they—and not the older ships—will occupy the van of the fighting line in the event of war being declared. The diagrams, therefore, are illustrative of these types alone, and are framed upon the displacement, indicated horse power, weight of metal thrown, energy of fire, extent of armament, and relative speeds of twenty-five vessels, sixteen of them being Spanish and nine from the United States. America has other ships available, but so has Spain, and a more useful comparison can be drawn by adhering to the more important ships.

The totals of displacement, indicated horse power, extent of armament, combined weight and energy of projectiles thrown in one minute's fire, together with the average speeds of the vessels contained in the two respective fleets, are shown comparatively on the diagram; so they need not be repeated in the text. But these totals are most instructive. It will be observed that the displacement of the United States vessels rather exceeds that of the ships of Spain; also that the guns are more in number. Here, however, any fancied superiority in the average qualities of the vessels composing the two groups ends. We have carefully analyzed the conditions as regards efficiency of fire, and separated the various types of quick-firing guns from those of ordinary character which happen to have the same caliber. The result of investigation, however, proves that, though the number of separate pieces of ordnance carried in the Spanish ships is less than that contained in the American squadron, the weight of metal thrown and the fire energy developed is far greater; the weight of projectiles fired usefully in one minute being 40,811 lb., or practically 20 tons, against only 37,808 lb.; while the fire energy is 1,529,516 foot-tons, against only 1,120,323 foot-tons as capable of being delivered by the ships of the United States. These are significant facts. The main factor in the product of gun power on the Spanish vessels is the output of energy created by the 47 quick-firing guns of 5·5-inch caliber; just as in our own squadron in Chinese waters, the chief element of gun power is derived from the 6-inch-quick-firing gun.

We ourselves, when visiting an important United States cruiser, took the opportunity of pointing out to the gunnery officer the unwisdom of mounting the old-fashioned 6-inch ordinary breech-loading gun in a brand new up-to-date ship of 22 knots speed. It is a fact, nevertheless, that out of thirty 6-inch guns carried in the United States ships now under consideration, only six are quick-firing. There is an important difference, too, as regards speed and handiness in favor of the Spanish vessels, the average rate of her ships being 23·67 knots per hour, against an average of 19·63 as ruling in those of the United States. This degradation in the average is due to the comparatively slow steaming of the three battleships. It is difficult to see where the usefulness of these heavily armed floating citadels comes in except to capture and sink the "Pelayo." The main factors of projectile weight and fire energy which the American squadron possesses are due to the slow-firing 13-inch and 8-inch guns of these battleships. Yet there is small chance of their ever catching a glimpse of the swift, handy armored cruisers of the "Vizcaya" type, and still less chance of getting an effective shot at them. Were these weapons the rapid-firing 8-inch guns recently perfected by the Elswick firm, and which—we are delighted to say—are to be mounted in our cruisers of the "Diadem" type, it would be quite another story. But they are not, and we fear that the United States may find that their obstinate determination to arm their new vessels with guns which are the creation of their own genius has landed them in a dilemma at this juncture. Spain has wisely copied and purchased some of the best guns of all nations, including the productions of Krupp and Schneider-Canet, and she is, relatively, in a better position now as regards the armament of her recent vessels than the United States.

The great difficulty for Spain will, of course, be centered in the fact that she fights from a base more than 3,000 miles away. When the coal supplies in Cuba and Porto Rico run out, she must depend upon colliers which can run into and from blockaded ports; and the United States armed mercantile cruisers should be able to render this a very perilous little game.

A great deal, too, depends upon the man behind the gun. The 3,000 Swedish sailors who are to form part of the complement of the United States vessels might be excellent material if fighting in defense of their own hearths and homes; but naval warfare of the present day is no pastime—it is a grim and ghastly reality, swiftly executed, and no hirelings of an alien state are likely to come well out of such a terrible ordeal. In point of fact, we do not believe that the Yankees thoroughly understand the spirit of mischief that they seem so determined to evoke."

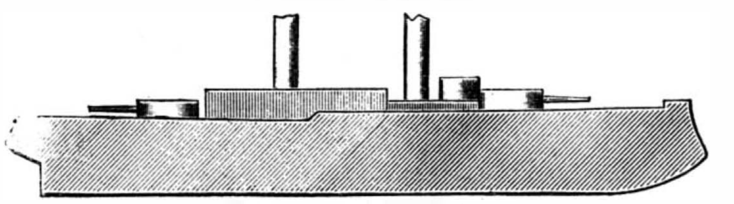
United States.	Knots.	Displacement.	I.H.P.	Guns.
Indiana	15·5	10,288	9,738	42
Massachusetts	16·2		10,403	
Iowa	16·1	11,410	11,000	44
Brooklyn	21·9	9,250	18,769	36
New York	21	8,200	17,401	30
Columbia	22·8	7,475	21,500	27
Minneapolis	23	7,475	21,500	27
San Francisco	20·2	4,083	10,400	22
New Orleans	20	3,600	7,500	24

The United States vessels are arranged in three groups: Battleships, armored cruisers and protected cruisers.

Spain.	Knots.	Displacement.	I.H.P.	Guns.
A. Oquendo	20	7000	13,000	28
I. Maria Teresa	20·25	7000	13,758	28
Vizcaya	21	7000	13,000	26
Cristobal Colon	20	6840	14,000	38
Emp. Carlos V.	20	9235	18,500	20
Pelayo	16	9900	8,000	19
Alfonso XIII.	20	5000	11,000	22
Lepanto	20	4826	12,000	20
Audaz	30	400	8,000	6
Furor	28	300	6,000	6
Osado	30	400	8,000	6
Pluton	30	400	8,000	6
Terror	28	300	6,000	6
Ariete	26·1	97	1,600	4
Azor	24	108	1,600	4
Rayo	25·5	97	1,600	4

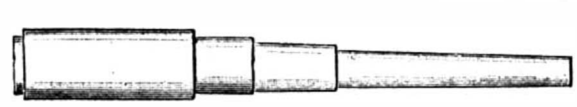
Spanish vessels in four groups: Armored and protected cruisers, destroyers and torpedo boats.

UNITED STATES.



Displacement, 72,069 *tons.*

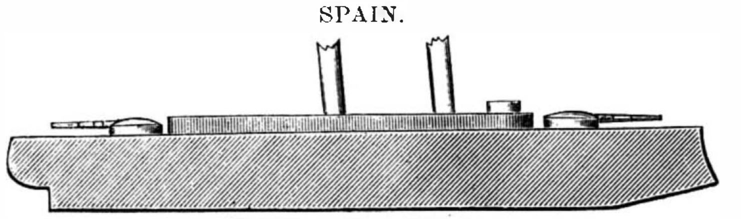
UNITED STATES.



Armament, 294 *guns.*

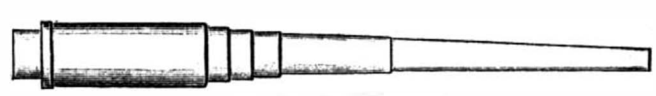
Metal Thrown and Fire Energy: 37,808 *lb.* 1,120,323 *Foot-tons per Minute.*

SPAIN.



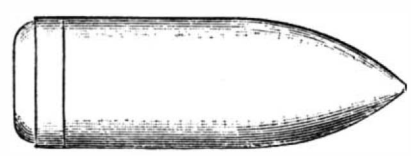
Displacement, 58,903 *tons.*

SPAIN.

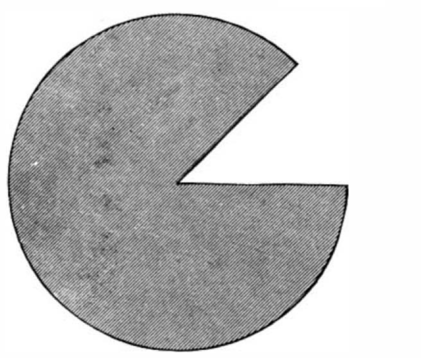


Armament, 243 *guns.*

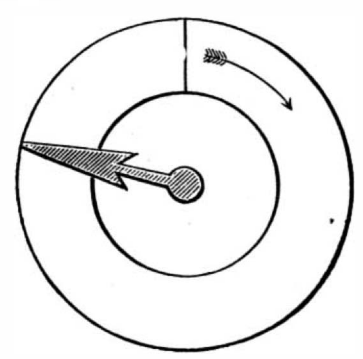
Metal Thrown and Fire Energy: 40,811 *lb.* 1,529,516 *Foot-tons per Minute.*



UNITED STATES.

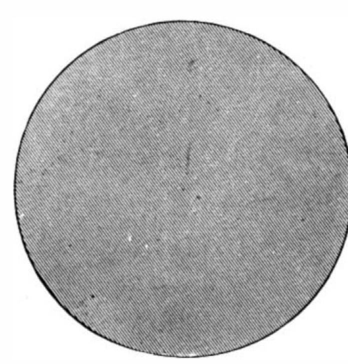


Indicated H. P., 128,211.

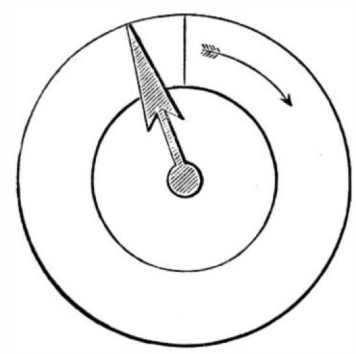


Average speed, 19·63 *knots.* *One revolution* = 25 *knots.*

SPAIN.



Indicated H. P., 144,058.



Average speed, 23·67 *knots.* *One revolution* = 25 *knots.*

ANALYSIS OF SPANISH AND UNITED STATES SQUADRONS.

ANALYSIS OF SPANISH AND UNITED STATES SQUADRONS—A REPLY.

We feel compelled to criticise an article which appeared in The Engineer of April 15, and is reproduced on this page, on the subject of the American and Spanish navies. The writer attempts to prove that the Spanish fleets in the Atlantic have a positive advantage over those of this country in every point of comparison save two. He professes to select from each navy the ships which would be available in West Indian waters to "occupy the van of the fighting line." Of these he finds sixteen in the Spanish navy and only nine in that of the United States, and working on this basis he figures out that Spain could silence our fleets by superior gun-fire and outmaneuver them by superior speed.

By way of showing the unfairness of the comparison in detail, as well as in its comparison of totals, we have drawn up the tables on the next page basing our selection of American ships upon the principle laid down by our contemporary, viz., that the ships must be up to date and capable of operating in our first line of defense. It will be seen at a glance that the whole comparison is mischievous and misleading.

In the first place, the United States is credited with nine instead of twenty-seven ships, or just one-third of the ships that are actually engaged in or available for the West Indian waters. Two of the ships omitted are battleships, one the "Oregon," of over 10,000 tons displacement and about 17 knots speed, carrying a heavier armor-piercing armament than any ship in the world to day; the other the "Texas," of nearly 18 knots speed, and armed with 12-inch guns, a ship presenting the most stable gun platform of any vessel in our navy.

Even after excluding eighteen out of the twenty-seven ships which on The Engineer's basis of calculation should have been enumerated, our contemporary finds that the United States ships have the larger total displacement, 72,069 tons against 58,903 tons; but the writer proceeds to discount this superiority by proving that our fleet is relatively cumbersome and slow. This he does by throwing in the speed of the eight Spanish torpedo boats in striking an average speed for the whole fleet, by which maneuver he reaches an average speed of 23·67 knots for the Spanish fighting line.

In order to render the comparison strongly favorable to Spain and keep down our average speed, not a single torpedo boat is credited to the United States, although we have eight of these craft actually employed in Cuban waters.

Having worked out a disadvantage in speed against our navy, The Engineer proceeds to prove that in gunfire we are hopelessly outclassed. This it does by making the false assumption that we have no, or practically no, heavy rapid-fire guns in our navy, and on this assumption, coupled with the fact that the Spanish ships are well supplied with rapid-fire guns, he figures out a total energy of gun-fire of over 1,500,000 foot-tons for Spain as against 1,120,323 foot-tons for the United States. In order to make this grossly erroneous showing, The Engineer has evidently not only failed to credit us with the 42 rapid-fire guns carried on the ships given in its table, but it has entirely left out of the table the four cruisers "Cincinnati," "Montgomery," "Marblehead" and "Detroit," which carry forty rapid-fire guns of 5-inch caliber as well as heavy secondary rapid-fire batteries. These four ships are as much entitled to be included in the comparison as are the protected cruisers Alphonso XIII. and the Lepanto. The fiction that our ships do not carry rapid-fire batteries is an old one with The Engineer, and, judging from the persistence with which it reappears, it is as popular as it is abiding.

Another curious fiction which is constantly cropping out is the idea that the United States monitors are not available in the fighting line. If our contemporary could be present in the preliminary skirmishes of the war, it would find that our monitors are very much alive, one of them having steamed into Matanzas Harbor and dropped 12-inch shells with precision into a battery which failed even to get her range; and another, also engaged in the blockade of the island, having chased and caught a 4,000-ton English-built liner that was endeavoring to run the blockade.

Our modern monitors are not to be confounded with their earlier prototypes. They carry complete Harvey steel belts, 9 to 14 inches thick, 11 to 14-inch Harvey steel barbettes and turrets and 10 and 12-inch modern high power rifles. It may surprise our contemporary to learn that even on the monitors are to be found batteries of 4-inch rapid-fire guns. They have moved with the fleets in all the operations of the war, and any Spanish fleet that hopes to raise the blockade will have to do so after penetrating the Harveyized turrets and resisting the 10 and 12-inch guns of our coast defense monitors.

In drawing up our comparative table of the fleets we have followed the only fair and logical course and separated the ships into classes. Any other comparison is entirely misleading, as in the case of the average speed shown in the table of the article referred to, in which the torpedo boats, whose total displacement is only 2000 tons,

BATTLESHIPS.

	Speed.	Displacement.	I. H. P.	Guns.
Indiana	15·5	10,288	9,738	42
Massachusetts	16·2	10,288	10,403	42
Oregon	16·8	10,288	11,111	42
Iowa	17·1	11,340	12,105	44
Texas	17·8	6,315	8,610	20
MONITORS.				
Puritan	12·4	6,060	3,700	20
Amphitrite	10 5	3,990	1,600	14
Miantonomoh	10·5	3,990	1,426	10
Terror	10·5	3,990	1,600	12
CRUISERS.				
Brooklyn	21·9	9,250	18,769	40
New York	21·0	8,200	17,401	32
Columbia	22·8	7,375	18,509	27
Minneapolis	23·1	7,375	20.862	27
San Francisco	19·5	4,098	9.913	22
New Orleans	21 0	3,600	7,500	24
Cincinnati	19·0	3,213	10.000	23
Montgomery	19·1	2,089	5,580	20
Marblehead	18 4	2,089	5,451	20
Detroit	18·7	2,089	5,227	20
TORPEDO BOATS.				
Porter	28·6	190	4,000	4
Dupont	28·5	190	4,000	4
Foote	24 5	142	2,000	3
Rogers	24 5	142	2,000	3
Winslow	24·5	142	2,000	3
Morris	24·5	103	1,850	3
Ericsson	24·0	120	1,800	4
Cushing	22·5	105	1,720	3

are allowed to pull the average speed of the whole fleet (58,903 tons) up to 23·67 knots an hour. In battleships we have five times the displacement, higher average speed, ten times the number of guns, and nearly four times the energy of gun-fire. In cruisers we have over 2,000 tons more displacement, slightly higher average speed, 40 per cent more guns, and over 180,000 foot-tons greater energy of gun-fire. It is only in torpedo boats that Spain is stronger, having double the displacement, 2½ knots greater average speed, more and heavier guns, and seven or eight times the energy of gun-fire. The greatly superior gun-fire of the torpedo boats is due to the fact that most of them are torpedo boat destroyers, and carry heavy batteries for the express purpose of sinking the enemy's torpedo boats.

Spain has absolutely nothing to oppose to our monitors, and if she wishes to release her beleaguered army, she must meet and break through a line of battle which will include these powerful ships.

There is another line of comparison which has been left out of The Engineer's article. We refer to the question of armor, as important an element as any in the whole comparison. Here, as the writer of the article must know only too well, the United States ships have a vast superiority. In the first place, the disposition of the armor is better. The heavy 10, 12 and 13-inch guns of our ships are protected from the water line to the roof of the turrets with a continuous wall of from 12 to 18 inches of Harvey steel. All the Spanish ships, even including the "Pelayo," have the fatal defect—so eloquently descanted upon by The Engineer at other times, but curiously ignored in the present comparison—that there is a space of 8 or 10 feet between the belt and the base of the barbettes which is absolutely without armor protection. This means that the searching fire of our rapid-fire guns will cut away the supporting framework below the barbettes, and tumble guns, turning gear and barbettes into the hold of the vessel. One well placed shell from our larger guns will do the same thing.

But what of the armor itself? Our ships carry our own Harvey steel, a make of armor for which the British Admiralty abandoned the old fashioned, faulty "compound" armor in a veritable panic when the superior excellence of the American product was proved a few years ago. If we mistake not, the building of ships in Spain was inaugurated under English supervision at a time when "compound" armor was considered the best. The keels of the armored cruisers were laid when these old ideas were prevalent, and it is probable that it is compound armor that clothes the Spanish cruisers to-day. If so, when our gunners begin to place 13-inch shells against the belts and barbettes of the enemy, they will see the steel face crack and fly from its backing in the same lively fashion that it did when we tested an English compound plate against our own Harveyized armor a few years ago. The Engineer shared the consternation which seized the British authorities at the time when the superiority of the Harveyized plate was shown, and it will appreciate the force of the suggestion as applied to the comparison of the American and Spanish ships.

In concluding our comparison, we draw attention to the last and most ridiculous fiction of the many with which The Engineer has regaled its readers in this article. We refer to the suggestion that the American navy is largely manned by foreigners, who will not fight with any zeal for the flag under which they sail. In the first place, the proportion of foreigners is exceedingly small, and, in the recent enlistments, the additions have been entirely native born. Even in the case of the small minority of foreign-born men-of-war's men there is an enthusiasm for the adopted country which is the natural outcome of the better pay, better food, more humane treatment, and general tone of self-respect which falls to the lot or characterizes the bearing of the boys in our navy.

In referring to the accompanying tables, it should be borne in mind that only such vessels have been included as are actually in commission and available for engagement, if necessary, in or near the waters of the Gulf and West Indies.

TYPE OF SHIP.	DISPLACEMENT IN TONS.		NUMBER OF GUNS.		ENERGY OF GUN-FIRE IN FOOT-TONS.		AVERAGE SPEED IN KNOTS PER HOUR.	
	UNITED STATES.	SPAIN.	UNITED STATES.	SPAIN.	UNITED STATES.	SPAIN.	UNITED STATES.	SPAIN.
Battleships	5 ships. 48519	1 ship. 9900	190	19	933600	263000*	16·7	16·0
Coast Defense Monitors	4 ships. 18030	None.	56	....	265800	....	11·0	....
Cruisers	10 ships. 49378	6 ships. 46901	255	182	1,606,296	1.426,000	20·45	20·18
Torpedo Boats	8 boats. 1134	8 boats. 2102	27	42	15187	113580	25·2	27·7
TOTALS	117,061	58,903	528	243	2,820,883	1,802,580†		

* Large energy due to her new armament of nine 5·5-inch rapid-fire guns. † We have made a liberal computation of the energy of Spanish rapid-fire guns, assuming them to be the Canet 50-caliber pieces in every case.

RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—Sturgeon Kershner, Blue Hill, Neb. In this engine a piston block on the shaft peripherally engages the cylinder, the block having spaced channels on opposite sides, each channel ending in an incline, having cam formations to be engaged by abutment bars slidable in the sides of the cylinders, the bars being supported to reciprocate at their outer ends. There is an inlet supply pipe at one side of the cylinder and an exhaust at the opposite side.

EXPLOSIVE ENGINE.—George A. Newman, Cliff, Neb. This invention comprises a pawl and ratchet mechanism connected with the main driving shaft, and one or more spiral springs attached by their inner ends to the ratchet wheel of the pawl and ratchet mechanism, while a piston moving in a cylinder is adapted to receive an impulse, the piston being secured to and carried by the ratchet wheel.

Bicycles, Etc.

BICYCLE TOE CLIP. — David Basch, New York City. This clip is preferably made of sheet metal, and has a bottom and a top and a front section, the latter being in the form of a divided hood, each section of which is capable of receiving a portion of the front and a portion of the side of a shoe. Lugs prevent the clip from shifting on the pedal and from having lateral or side movement.

Musical.

MUSICAL INSTRUMENT. — P. Casolin, New York City. In this instrument, belonging to that class in which guitars are included, the neck and body are separable, the latter having a recess with sloping sides opening to one side and adapted to receive the similarly shaped end of the neck. A plate is located at the bottom of the recess and is provided with slots extending to the open edge of the recess; another plate is located on the end of the neck and is provided with bars adapted to fit into the slots in the plate of the recess. The purpose of the invention is to render the instrument more portable.

Metallurgical.

APPARATUS FOR MAKING CHILLED IRON CASTINGS.—A. K. Barber, Boonton, N. J. This machine for making chilled castings at a comparatively low cost consists essentially of a rotating table carrying a series of chill moulds, a central water supply with branches leading to the moulds and a subjacent annular trough which receives the discharge water from all the chill moulds. The operation of the apparatus is nearly continuous and the time employed in manipulating the machine is exceedingly short.

Mechanical.

THILL COUPLING.—Zadoc L. Wheeler, Cedar Falls, Ia. This thill coupling has a clip with two transversely alined eyes through which a pin passes having a head with two upbent ends, one end forming an eye and the other a hook. A retractile spring is permanently engaged at one end with the eye on the head of the pin. The other end of the spring has a loop capable of removable engagement with the hook on the head of the pin.

Agricultural.

PLOWSHARE.—Frederick Wolf, Quincy, Ill. The plow, in addition to turning the soil, is made to pulverize by means of teeth which are formed on the front of the share and on the landside.

Chemical.

FORMALDEHYDE STARCH AND ITS MANUFACTURE. — Alexander Classen, Aix-la-Chapelle, Germany. The process for the manufacture of compounds of starch and formaldehyde for which this patent was granted consists in causing the various substances to react with formaldehyde and heating the products of the resulting reaction for 24 hours to a temperature of 120° C. The compounds thus obtained are again treated with formaldehyde and then freed from the excess thereof by means of a solvent of formaldehyde. They are then dried.

Electrical.

APPARATUS FOR REDUCING ELECTRIC CURRENTS AND VOLTAGE. — Alexander F. Vetter, Long Island City, N. Y. This invention provides a means for using a high voltage current in the operation of devices, such as medical appliances, requiring a current of lower tension. The apparatus comprises a supply circuit, a shunt circuit in which is included the appliance to be operated, and a switch by means of which a portion of a resistance placed in the supply circuit may be transferred to the shunt circuit. Another resistance controls the current strength. The amperage of the current may be varied as well as its voltage.

Miscellaneous.

PRESSING BOARD. — Louis Siegfried, Easton, Pa. The pressing board is carried by a post at the lower end of which a suitable clamp is provided for securing the devices to a table. The post is mounted to rotate and has clutch devices for holding it in a given position, and the board is pivoted to swing down when not in use.

VALVE CONTROLLING DEVICE FOR GAS BURNERS.—Joseph D. C. Chateau, Paris, France. In connection with a valve in the burner, a permanent magnet and an electromagnet are employed, the electromagnet, by reinforcing or opposing the permanent magnet, according to the direction of the electric current, serving to control the valve.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7422) A. J. F. asks: 1. Can cast iron field magnets be used in making the motor designated in SUPPLEMENT, No. 641? A. Yes. 2. Can cast iron be softened? If so, how? A. The quality of the iron determines its hardness when cast. Only the best should be used, soft gray cast iron. 3. Can a cast iron core be used for the armature of the above motor? A. Do not use cast iron for armature cores. 4. Give a formula for an acidproof cement? A. Sulphur, 100 parts; tallow, 2 parts; resin, 2 parts. Melt these together to a ruddy sirup, add sifted ground glass to form a paste, and heat when used.

(7423) C. H. J. asks: 1. Could a gas generator such as you describe on page 260 (April 23) be made to generate a pressure of 10 to 15 pounds per square foot by adding weight to the inner tank? A. Yes, if the tank is high enough to balance pressure by the water seal, but this is not practicable. 2. How long will the generator as described, with one charging, burn a regular 4 foot burner? A. One pound carbide generates 5¾ cubic feet acetylene. One foot burners are as large as can be used. 3. Can acetylene gas be used in either a Bunsen or Welsbach lamp either for heating or illuminating? A. Yes; by diluting the gas at the burner with a small portion of air, as in a Bunsen burner. 4. Would acetylene gas deteriorate if stored in a tank for several hours? A. It is a permanent gas and will keep in storage as other gases. 5. Have you given a full description of a generator in any of your SUPPLEMENTS? A. For illustrated articles on acetylene gas, see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1057, 1149, 1150, 10 cents each mailed.

NEW BOOKS, ETC.

THE STATESMAN'S YEAR BOOK. Statistical and Historical Annual of the States of the World for the Year 1898. Edited by J. Scott Keltie. With the assistance of I. P. A. Renwick. Thirty-fifth annual publication. Revised after official returns. London and New York: Macmillan & Company, Ltd. 1898. Pp. xxx, 1166. Price $3.

It is not too much to say this book is one of the most valuable and important publications which is issued anywhere in the world. While libraries, newspapers, etc., absolutely require every volume of this splendid compendium, the average reader will be satisfied with one every two or three years. It is brimful with the most recent and important statistics derived from the best sources. The volume, which comprises nearly 1,200 pages, treats of the constitution and government of every country and colony of the world, with full particulars as to area, population, religion, instruction, justice, crime, pauperism, finance, defense, production, industry, commerce, shipping and navigation, internal communications, money and credit, weights and measures and bibliographies of important and up to date books. The information is given in concise sentences, and the tables are reduced for the sake of clearness to the lowest terms. The bibliographical matter is of the greatest possible value, referring as it does to the very latest publications, to which the reader is directed for further information. This book is simply invaluable for the library and it is very surprising that a work which requires such great labor by trained statisticians can be sold for so very moderate a price.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

APRIL 26, 1898,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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Advertising device, M. Duffner.... 603,057
Air and gas mixing apparatus, W. C. Clarke.... 602,828
Air, etc., compressor for, H. C. Sergeant.... 602,877
Air distributor or spreader, J. Jauch.... 603,105
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